BLM LIBRARY
88068358

# LAND USE PLAN
# DELCOAL PROSPECTING
# PERMIT EXTENSION

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Stu Carlson 2/19/71

Team Leader Date

Howard 2-23-71

Kanab District Manager Date

HD
242.3
D45
1971

#903961759
ID88068358
HD
242.3
D45
1971

2900
LaBu

3500

TABLE OF CONTENTS

I. Introduction

II. Background

III. Field Description

A. Location & Extent

B. Topography & Drainage

C. Vegetation & Wildlife

D. Population, Industries & Transportation

E. Climate

F. Coal Seams

G. Land Ownership

H. Water

I. Economics

IV. Carcass Canyon Quadrangle Area

V. Analysis & Recommendations

VI. Reclamation & Surface Protection Stipulations

VII. Maps & Photos

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

# *Memorandum*

3500
P-4

TO : State Director, Utah

DATE: February 23, 1971

FROM : District Manager, Kanab

SUBJECT: Delcoal Prospecting Permit Extension Report

Re: 43 CFR 23, BLM Manual 3500

Enclosed is the recently prepared Kanab District land use plan for the subject extension. The plan is a deviation from past reports in that my staff attempted to analyze and plan for the extension in relation to total resource management (coal, oil, soil, water, etc.) within the overall locale, rather than just upon the subject ground. This approach was also one of the recommendations put forward recently by Messrs Montgomery and Neuberg during their mineral investigation of the district.

The land use plan will hopefully be used as a prototype for subsequent 43 CFR 23 reports in this locale. An example would be the competitive leasing of the three coal areas or the pending Woods Petroleum prospecting extension report. The plan is somewhat area wide in scope and will be periodically augmented or updated as our planning progresses for the Carcass Canyon Quadrangle. Primarily, we hope to utilize its format as an inshop working tool and also as a composit means of analyzing data and plans from our Escalante URA and MFP.

Continued oil plus coal development is anticipated indefinitely upon the Kaiparowits Plateau both southwest of Escalante and farther south upon Smokey Mountain. Accordingly, we hope that this type of study can be used as a BLM guide for coordinating surface management decisions with respect to all future mineral programs. As an example, it will probably be highly valuable in projecting or relating access needs upon the entire plateau for all resources instead of just for the Delcoal permit.

Due to the urgency of getting the report up to USO, we were unable to get copies made of the overlays as discussed earlier with Mike Stats. Dan Jones has agreed to send them down to GSA for duplication, however.

Enclosure
land use plan

*Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan*

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

# *Memorandum*

3500
P-4

**TO** : Assigned Personnel

**DATE**: Dec. 22, 1970

**FROM** : District Manager

**SUBJECT**: Technical Examinations - Delcoal Prospecting Permit Extensions
Utah 1375, 5233-37, 7275 & 7276
Ref. 43 CFR 23, BLM Manual 3500

A 43 CFR 23 report is needed by USO before the extension is granted. Stu Carlson is assigned as team leader. Please return your reports on memo form to him. Team members are assigned as indicated upon attached form 3040-3. Responsibility for the respective reports rests with the name underlined.

Bear in mind that the subject area contains significant coal deposits and may someday be developed and mined. The area manager is still expected to make contact with USGS for a joint fieldtrip as per USO instructions. Stu will prepare the final document but this is still your area.

It is suggested that as you conduct your field investigations, attempt to plan future resource uses and management development for the entire locale or drainage area and then fit the subject land into the big picture rather than solely locking-in on just the subject land. Give major consideration to access needs as it affects the various resources.

In the past, BLM was limited to reclamation enforcement after an operation terminated. We now have the regulatory authority to also preplan the program before it starts with respect to protecting the environment and other resources.

*Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan*

5010-108

I. Introduction

## I. Introduction

This report was prepared subject to surface management requirements for exploration, mining, and reclamation as set forth in 43 CFR 23 and BLM Manual 3509. Members of the study-surface protection team include:

Stu Carlson - Kanab Team Leader

Scott Packer - Kanab (recreation, timber, & environment)

Bill Lamb - Kanab (livestock, watershed, access and wildlife)

Gavin Goudie - Kanab (watershed access)

Darwin Snell - Kanab (access, fire, livestock

Clark Draper - Kanab (watershed)

Form 2060–1
iary 1969)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

# LAND REPORT TITLE PAGE

| | | |
|---|---|---|
| State<br>Utah | District<br>Kanab | |
| County<br>Garfield | Resource area<br>Escalante | Planning Unit<br>Escalante |
| Type of Action<br>Coal Prospecting Extension | | Serial Number<br>Utah 1375, 5233-37, 7275 & 7276 |
| Applicant's name<br>Delcoal Inc. | Address *(include zip code)*<br>Kansas City, Mo. | |

Date(s) of examination December 1970

## LANDS INVOLVED

| TOWNSHIP | RANGE | MERIDIAN | SECTION | SUBDIVISION | ACRES |
|---|---|---|---|---|---|
| 36 S | 2 E | SLM | 13 | S½NE¼, SE¼ | |
| | | | 14, 23-26 | All | |
| | | | 35 | All | |
| 36 S | 3 E | SLM | 19, 30 | All | |
| | | | 31 | Lots 1 and 2, E½ | |
| 37 S | 2 E | SLM | 1, 11-13, | All | |
| | | | 14 | NE¼, E½SE¼ | |
| | | | 24-25 | All | |
| 37 S | 3 E | SLM | 5-7 | All | |
| | | | 18 | Lot 1 to 4 incl., E½NW¼ | |
| | | | 19 | Lots 1 to 4 incl., | |
| | | | 27 | SW¼ | |
| | | | 28 | S½, S½NE¼, E½NW¼ | |
| | | | 29 | S½ | |
| | | | 30 | Lots 1 to 4 incl., E½W½, SE¼ | |

Purpose of report

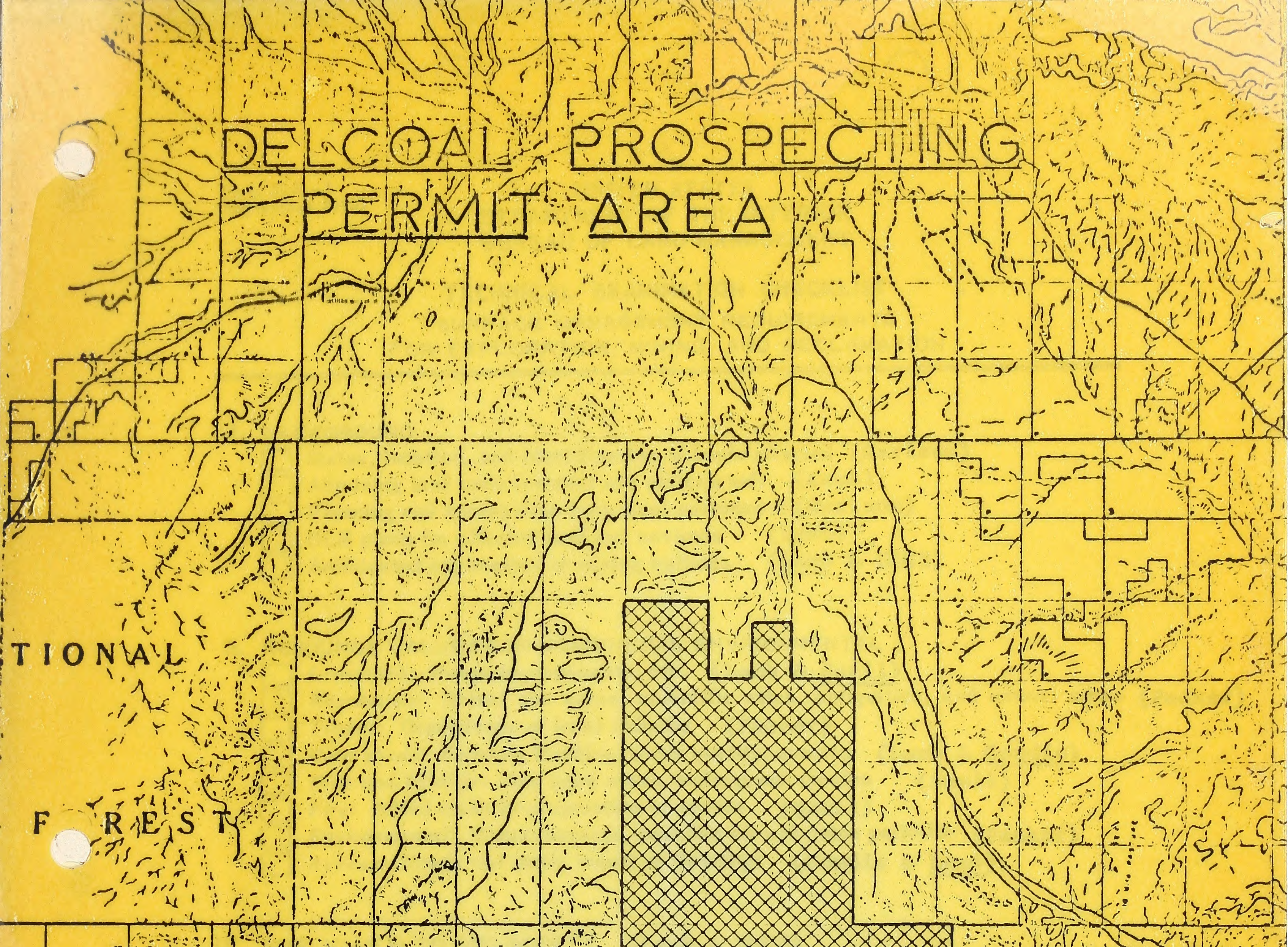
43 CFR 23 Report for 15,010 Acres

| | | |
|---|---|---|
| Prepared by<br>Otis Carlson | Title<br>Realty Specialist | Date of report |

GPO 848-296

| Township | Range | Meridian | Section | Subdivision |
|---|---|---|---|---|
| 37 S | 3 E | SLM | 31 | Lots 1 to 4 incl., E½W½, E½ |
| | | | 33 | All |
| | | | 34 | W½, W½E½ |

# DELCOAL PROSPECTING PERMIT AREA



Form 3040-3
(September 1970)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

# TECHNICAL EXAMINATION CHECKLIST

## SURFACE MANAGEMENT REQUIREMENTS
## FOR EXPLORATION, MINING, AND RECLAMATION

---

### I. BACKGROUND

☐ Status, location, and identification of lands affected (Carlson)
☐ Adjoining land uses (present and anticipated) (Lamb)
☐ Planning and zoning data from local government (Carlson)
☐ BLM plans for affected land and environs (Lamb)
☐ Anticipated exploration or mining methods (Lamb & USGS)

### II. RESOURCE VALUES FOR NONMINERAL ENVIRONMENTAL

☐ *Livestock:* Range improvements, etc. (Lamb & Snell)
☐ *Recreation:* Actual use areas, scientific sites, antiquities, and natural areas (Packer)
☐ *Timber:* Dependence of local industry (Packer)
☐ *Watersheds:* Erosion, flooding, water quality, quantity (Lamb & Goudie)
☐ *Fish and Wildlife:* Key game areas, endangered species (Snell)
☐ *Fire:* Added risks from operation or access (Snell)
☐ *Environmental:* Scenic aspects, possible air and noise pollution (Packer)
☐ *Access:* Roads and trails (asset or liability) (Goudie & Lamb)

### III. PUBLIC HEALTH AND SAFETY (Lamb & USGS)

☐ Toxic materials
☐ Fire hazards
☐ Landslide potential
☐ Hazardous exploration or mine workings
☐ Dust
☐ Flooding
☐ Waste disposal (mine, mill, domestic, etc.)

### IV. SOCIO-ECONOMIC CONSIDERATIONS (Carlson)

☐ Present and projected demand for the mineral materials
☐ Effect on local economy and employment
☐ Impact on other resource values (temporary or permanent)

### V. ENVIRONMENTAL CONSIDERATIONS AND RECLAMATION REQUIREMENTS (Lamb & Carlson)

☐ Damage to natural scenic, historic, or esthetic features
☐ Possible enhancement of future land use by proper reclamation methods; grading, shaping, filling, revegetation, water impoundment, and control
☐ Bonding requirements

# II. Background

## II. Background

The demand for electrical power in the Southwest in recent years has focused attention on the southwestern Utah coal fields. Southwestern Utah has one of the largest undeveloped bituminous coal reserves in the United States. Geographically, it is the nearest large reserve to the burgeoning energy market of southern California and Arizona.

For many years the presence of coal in southwestern Utah has been recognized. Without a method of economically transporting the coal energy to a market, little interest has been shown in these deposits. Also retarding development have been the factors of insufficient water supply, inaccessibility of the region, and moderately high ash and sulfur contents. However, in recent years with the advent of 500 Kv extra high voltage (EHV) transmission lines, reduction in coal transportation costs by unit trains and slurry pipelines, and adequate water supplies in sight from Lake Powell and possible ground-water sources, the coal fields in southwestern Utah are forging into prominence as a vast source of power competitive with conventional oil, gas, and hydro sources.

The Kaiparowits Plateau coal field attracted little attention until 1960. A sort of land "boom" followed in which private companies and individuals prospected and leased the plateau coal lands. Up to January 1, 1970, 371 square miles of land had been so appropriated.

The coal of the plateau is in lenticular seams and confined to several zones. Of these the Christensen (Henderson), Alvey, and Rees

coal zones, all in the Straight Cliffs Formation of Cretaceous age, are the most important. All of the coal beds four feet or more thick are confined to a northwest-trending belt paralleling old shore lines that is about 18 to 25 miles wide.

Reserve calculations for the field, according to the University of Utah (1970) including all classes of reserve total 15.2 billion short tons of coal. Between 7.2 and 11.1 billion tons are classed as either indicated or inferred reserve dependent upon the source of information. This study has placed almost 4 billion tons in indicated reserves, other estimates place the figure at 7.2 billion tons. Coal in seams less than four feet in thickness were omitted from the calculations. The minable portion of the coal will fall between 33 and 50% of these amounts.

The rank of the coal ranges from subbituminous C to high-volatile bituminous A. Generally the lower rank coals are located in the northwestern part of the field. Field averages for dry coal indicate 44.33% volatile matter, 46.60% fixed carbon, 9.06% ash, with 11,712 Btu/lb. The sulfur content averages 1.09%, dry basin, but the figure is believed to be high inasmuch as several analyses from a high-sulfur mine were included. Average sulfur for the field is believed to be between 0.9 and 1.0%.

The quality of the coal limits its use to power generation. The coal should lend itself well to gasification and liquefaction beneficiation when those processes become competitive with the naturally produced substances. The coal might be used as an item of export by

construction of railroads or coal pipelines, although rail construction would be hampered by natural topographic barriers.

The coal of the Kaiparowits field is found in a remote area, in South Central Utah, in a dry climate, in which little is known about its water resources. Conservation groups are working to preserve at least part of the region in wilderness or recreation areas and impede development of the resource. These factors and competition from coal producers in New Mexico and Arizona, who have strippable mines are serious impediments to its development. The geology of the Kaiparowits coal deposits is such that most will have to be deep-mined. Nevertheless, it is expected that a power-generating facility will be operating fired by Kaiparowits coal no later than 1980.

Resources Company initiated mine recovery tests upon their Smokey Mountain lease lands in January 1971 while speculation continues concerning Utah Power and Light development upon the Escalante River near the Carcass Canyon-Collets deposits.

In January 1971, Utah Power and Light submitted to Kanab BLM an application for a Special Land Use Permit to construct a stream flow gauging station on the Escalante River.

# III. Field Description

## III. Field Description

### A. Location and Extent (See Map I)

The Kaiparowits Plateau coal field is found entirely in Garfield and Kane Counties. The field is about 54 miles across its greatest width at the southern end and is 66 miles in extent from north to south. This includes an area of approximately 1,600 square miles. The field is limited by the edges of the Cretaceous outcrop, i.e., at the base of the Dakota Formation outcrops along the Straight Cliffs (Fifty Mile Mountain) to the east, the base of the overlapping Tertiary strata of the Table Cliff and Aquarius Plateaus to the north, the Paunsaugunt fault and the base of the Dakota Formation outcrops along the East Kaibab monocline to the west, and the base of the Dakota Formation outcrops along the deep canyons of the Colorado River system to the south. It is contiguous to the Alton coal field to the west and is separated from it by the prominent Paunsaugunt fault.

### B. Topography and Drainage

Topographically the area is one of undulating plateau surfaces deeply incised by drainages producing steep-walled canyons. It is along these canyon walls that the coal seams are exposed. The trend of the drainages in the southern part of the field is southeast toward the Colorado River. This southern part of the plateau is a natural geographic division useful in dividing coal areas and is designated the Smokey Mountain area. No important drainages cut across the East Kaibab monocline. In the area near the town of Tropic there is

an amphitheatre opening to the south. Several drainages from the northeast, north, and northwest collect in the amphitheatre to produce the south-flowing Paria River. The coal cropping out along the walls of this amphitheatre are in a natural sub-division designated the Tropic area. In the northern part of the plateau east of the Table Cliff Plateau the drainages are basically eastward supplying water to the Escalante River. Only two important drainages, Left and Right Hand Collet Washes, cut across the monotonous Fifty Mile Mountain cliff extending from the town of Escalante to the Colorado River. These waters also feed the Escalante River. All the eastward draining canyons expose coal belonging to the third natural division, the Escalante area.

? Continuous maybe but not monotonous

If one discounts the erosional remnant of the Table Cliff Plateau south of Upper Valley known as Canaan Peak (Kaiparowits Peak), elevations are in the northern part of the field and along Fifty Mile Mountain. The lowest are along the Dakota outcrops in the southern end of the field. The average elevation is about 6,000 feet avove sea level. Coal seams are found throughout the entire range of elevations.

## C. Vegetation and Wildlife

Vegetation on the plateau can be divided into zones based on elevation and rainfall. The highest zone is the yellow pine forest that flourishes above 7,300 feet. It features stands of ponderosa pine, Douglas fir, and the juniper. In these areas thick soils and heavy

vegetation tend to conceal the coal seams. These areas receive a substantial amount of moisture each year, in excess of 18 inches. Most of the plateau surfaces and many of the canyon walls are between 5,500 and 7,500 feet above sea level which marks the pinon-juniper zone. These areas receive from 12 to 18 inches of rainfall which are typically identified as "pygmy" forests. These woodlands are often interrupted by sagebrush and grasslands. Scattered in the forests and sagebrush areas is abundant rabbit-brush, mountain mahogany, Mormon tea, yucca, prickly pear, and serviceberry. Along the more reliable stream courses oak, willow, burch, sumac, broad-leaved cottonwood and other forms can be found. In recent years large stands of the "pygmy" forests have been removed by a process called "railing" and the areas have been reseeded with grasses. These "railed" areas then form excellent grazing lands which conserve water as the grasses tend to have a lower transpiration rate than the trees. The pinon (Pinus edulis), however, is the source of pine nuts, an important food of the former native Indian inhabitants. Soil formation in this zone is normally poorly developed, is never very thick and coal seams are more easily followed. Rock falls and landslides on the canyon walls are plentiful and interrupt an otherwise ideal condition. The coal has burned naturally along outcrops in many localities at these elevations, but this process is not as pronounced as in areas of less rainfall.

As one drops lower than 5,500 feet, the trees thin out and become

stunted in their growth. Eventually they disappear completely. Most of the areas below that elevation belong to the northern desert shrub zone. Rainfall is sparse, normally less than 10 inches and individual plants are separated from each other by bare ground and rock. The vegetation itself varies from place to place being dependent upon local drainage conditions, soild, parent rock, and exact precipitation. Stands of sagebrush are found where the surface is well-drained and the soil is free of soluable salts in the wetter areas. Rabbitbrush, Mormon tea, prickly pear, and snakeweed are often associated with the sage. Shadscale is abundant where the ground is less permeable than in the sagebrush areas, it has the same associates and can stand less moisture. Blackbrush and sand sage are found in more sandy areas. Along stream courses there is low salinityor alkalinity and one finds cottonwoods, sumac, willow, and other phreatophytes. Salt desert shrub areas exist where soils contain much salt and/or alkali and where the groundwater is close to the surface. Greasewood and its associates are found in valley bottoms where the soil is moderately saline and compact. If the soil gets too sandy greasewood is quickly supplanted by shadscale. Samphire is restricted to areas of ubiquitous flooding and high salt; saltgrass grows in areas of high salt content--it can stand as much as one percent salt. The total area involved in the salt desert shrub zone in the Kaiparowits Plateau area is relatively small. In areas where the soil or parent rock is very non-permeable very little vegetation

is found at all. This is typified by exposures of the Tropic Shale. In contrast to the Pinon-Juniper zone the northern desert shrub and salt desert shrub zones have outcrop coal naturally burned as a rule rather than as an exception. The only seams not affected are the thinner ones.

A variety of wildlife abounds on the Kaiparowits Plateau of which the most notable consist of rodents, lizards, amphibians, birds, and arthropods. Prior to the white man's influence large mammals such as bear, antelope, deer, mountain sheep, cougar, and bobcat are reported to have been abundant. Presently only the mule deer is frequently seen but an occasional cougar also crosses the visitors path and the occasional howl of the coyote creates the melody for the music of the night, the rhythm being supplied by croaking frogs and chirping insects. The more abundant mammals include ground squirrels, pocket gophers, woodrats, cliff mice, bats, jackrabbits, and contontails. There are a variety of birds, most commonly hawks, flycatchers, swallows, woodpeckers, and owls. Lizards such as the sagebrush swift, desert whiptail, and horned toad are abundant. The most common snake seen is the rattlesnake, the only poisonous reptile; but gopher and garter snakes are also seen. Most of the more reliable streams are infested with several species of frogs and toads. The full-grown size of these amphibia ranges from one-quarter inch to four inches in length. Even in the driest areas it is not unusual to find small potholes alive with tadpoles.

The most obvious and obnoxious segment of the "wildlife" is the arthropod population, which makes its appearance in large numbers during the warmer seasons. There are varieties which enjoy the drier areas and varieties which enjoy the more humid areas. There are those which abound at high altitudes and those that are seen only at the lowest elevations. Some are only found in mines and under cliffs. Species of spiders, centipedes, scorpions, and insects thrive in all areas. The many varieties are always a threat to comfort of an individual threatening their domain. The most disagreeable are the gnats, biting flies, yellow jackets and blow flies. Mosquitoes are a problem near standing puddles of water. The most interesting insects are the giant water beetles (up to three inches long) which feed upon frogs and locusts whose moults give a frightening appearance to the passerby.

## D. Population, Industries, and Transportation

Man's use of the Kaiparowits Plateau is basically limited to grazing. An important oil field exists along the Upper Valley anticline in the Garfield County portion north-central part of the plateau. Other than the 5 small communities which are located on the fringes of the coal field there are no permanent residents. Most of the plateau is accessible only by four-wheel drive roads and by-and-large the region is accessible only to the most venturesome of individuals. The poor roads extend for as much as 100 miles without any chance for the obtaining of fuel or water. There are large areas where no roads exist and where it would be difficult to use a horse to advantage.

The two major and paved roads are U.S. Highway 89 and Utah Highway 54.

Highway 89 skirts the southwest edge of the Kaiparowits Plateau joining Kanab, Utah with Glen Canyon Dam and Page, Arizona. The small village of Glen Canyon Dam and Page, Arizona. The small village of Glen Canyon City lies below the Kaiparowits Cliffs just north of the highway. People living at the village are mostly employed at Glen Canyon Dam. Highway 54 drops into the Tropic amphitheatre through Tropic Canyon from the Paunsaugunt Plateau (Bryce Canyon) and connects the three hamlets of Tropic, Cannonville, and Henrieville, then crosses the Kaiparowits Plateau to Escalante to the east. Each of the amphitheatre towns had a population of approximately 150 in 1960, Escalante had 700. The town populations are involved in agriculture (ranching, grazing, farming), providing support personnel for the National Park Service, the National Forest Service, and Bureau of Land Management, working for a local sawmill (Escalante) drawing lumber from the higher plateaus, and providing goods and services to oil well operators and tourists. Other important graded roads include the Widtsoe Junction-Escalante (Main Canyon) road, Cottonwood Creek road, Alvey Wash road, Smoky Mountain road, Hole-in-the-Rock road, and the Upper Valley oil field road. Their access is shown on the topography and road maps appended to this report. During the summer numerous flash floods cause the roads to be washed out and local inquiry may save the traveler hours of wasted time.

The nearest railroad is about 75 straight-line miles northwest of the central Kaiparowits. This spur of the Denver and Rio Grande Western Railway is at Marysvale in Piute County and joins the main

line at Thistle, Utah some 150 miles to the north. The main line of the Union Pacific Railroad is about 125 miles west of the Kaiparowits and the Cedar City spur comes almost as close as that of the Denver and Rio Grande. The lands between the railroads and the Kaiparowits are rough and of high relief and it would most certainly be expensive to extend the railroads to the coal field. The nearest regularly served airport is at Page, Arizona just across the Utah border near Glen Canyon Dam. Several dirt landing strips are located on benches on the plateau.

## E. Climate

As previously mentioned rainfall varies between 6 and 20 inches depending upon altitude indicating a steppe climate. This means that evaporation needs precipitation and water becomes a scarce item especially in the lower altitudes (water is discussed separately in the water resources section). High areas generally have two peaks in precipitation, one in the winter months due to cyclonic storms and one commencing in late June or early July due to convection. The convectional storms are usually short-lived, spotty, but often very severe causing great damage in the form of flash floods. The lower areas have similar but subdued peaks, storms are less frequent. The driest part of the year is usually Spring. The average high temperature during July in Escalante is almost 90 degrees. At the southern edge of the Kaiparowits Plateau below the cliffs the average high temperature will be about 100 degrees in that month. Evening temperatures during July will range between

50 and 60. The average low temperature during January is about 13 degrees and the average high about 41 degrees at Escalante.

## HISTORICAL OUTLINE

The history of the Kaiparowits Plateau and related areas surrounding the Plateau is sparse owing to its remoteness and inhospitable environment. Few communities have thrived for long in this southern Utah desert.

That the American Indian built a minor culture in the sandstone cliffs and deep dry canyons is evidenced in the numerous arrowheads, pottery shards, and Indian dwellings found while traversing the plateau. On one occasion, while negotiating a cliff, a carved stairway was encountered leading up a ledge to the remains of an old Indian village. Whether the Indians made use of the conspicuous coal for fuel is not likely.

Possible - Hopi did!

As reported in the University of Utah Anthropology Paper Nos. 66 and 71, an expansion of the Pueblo Indian nation brought splinter groups into the Kaiparowits area between 1,050 and 1,200 A.D. It is also noted that the Ute Nation had some influence in the northern parts of the plateau in the high mountains where water and game were plentiful. More recent tribes were the Navajos and Piutes which the "white man" encountered in the area. In these high regions, in the northern part of the field, there stands a high peak which the Indians revered. Its Ute Indian name was Kaiparowits; today it is called Canaan Peak.

In 1776 a party of Spaniards headed by ~~one~~ two Father Escalante, a Franciscan friar, entered the Kaiparowits area seeking a crossing on the Colorado River. One of their encampments at the eastern base of the Table Cliffs Plateau is near where the present town of Escalante stands today. Their crossing of the Colorado River was unique. The spot where the corssing was made in the southeast part of the area was called "The Crossing of the Fathers" and later became a favorite landmark. It has since been deluged by the raising of Lake Powell. Later trappers and adventurers were familiar with the area, but regarded it as unprofitable as a source of livelihood and thus contributed little to the history of the area.

The exploration of the Colorado River by Major J. W. Powell and his party in 1869 did much to add information about the plateau area. The Colorado River was proved navigable and the Kaiparowits drainages explored. The second Powell expedition, 1871, added much to the general knowledge of the area through the work of A. H. Thompson, a competent topographer, who named the plateau after the Indian name for Canaan Peak, Kaiparowits. Other explorers contributed more information; these include Wheeler, Marshal, Groves, and Dutton to name a few.

A point of interest is the Indian name for Major Powell: Ka-pu-rats, meaning "one arm off" referring to Powell's lost arm. This is phonetically similar to Kaiparowits.

The pioneers seeking new lands to settle pushed south into the

Though the coal of the Kaiparowits was known and mined in early years, it had not been systematically studied until Gregory and Moore studied the area and published their work in 1931. This work provided the basis for geologic work in the following years. Robison, Gross, and Peterson, to name a few, have done detailed studies of the geology and coal to enhance and make possible the exploitation of the natural resource.

Mining of the Kaiparowits coal was initiated soon after the first settlers became established. In the Alvey Wash area, south of Escalante, mines were opened to support the needs of the local citizenry. Mining alwo followed the establishment of the communities in and around the Tropic amphitheatre. The Shakespear mine is most notable. In 1913 the Spencer mine was opened in Warm Creek on the southeast edge of the Plateau. The coal was used to run a river boat on the Colorado River. It is also reported to have been used as a fuel at gold mining operations on the Paria River. (Averitt and Cashion, 1965).

Mining continued with some prosperity through the early 1900's with the market being limited to local needs. Increased activity seems to have taken place at the turn of the century to the 1920's. Then it was revived again in the early 50's and 60's. Presently, all mines are closed, many are abandoned and caved or in a state of disorder. Conversion from coal to other fuels is the apparent cause.

A list of the important mines and their productions, where available, is as follows:

| Mine | | |
|---|---|---|
| Alvey | 1920-1962 | Average 1200 T/yr. |
| Cherry Creek | 1962-1964 | Average 214 T/yr. |
| Christensen | 1893-1930 | Average 100 T/yr. |
| Corn Creek | ? | ? |
| Davies | 1952-1953 | About 100 Tons total |
| Pollock | 1920-1925 | ? |
| Richards | 1913-1928 | Average 100 T/yr. |
| Shakespear | 1952-1964 | Average 480 T/yr. |
| Shurtz | 1913-1928 | Average 100 T/yr. |
| Schow | 1893-1930 | ? |
| Spencer | 1910-1913 | 115 Tons total |
| Winkler | 1920's | ? |

Lands set aside for coal leases have been acquired by many major companies though the "little man" has his share also. Many of the early mine properties are still held by their original owners and spirits are high in anticipation of a future coal mine boom. Exploration activity for coal has given the various communities an economic "shot in the arm."

The convenience of the Colorado River and the middle tributaries as a source of water makes possible steam-powered electric plants in the area.

## F. Coal Seams

The Escalante area of the Kaiparowits Plateau coal field according to the University of Utah contains a little less than 3.5 billion tons of reserve in five coal zones. These five coal zones are, in ascending order, the Dakota, Christensen, Rees, Alvey, and Upper Alvey. In addition there is another zone (lower coal zone) containing coals of poor quality in thin seams.

The Dakota coal zone fringes the Kaiparowits Plateau along its northeast edge in the Escalante area. The coal in the unit rarely acquires seams greater than four feet in thickness, but in the Dave Canyon quadrangle, a few miles south of the town of Escalante, several sections indicate coal between four and five feet thick. The seams are found at the foot of Fifty-Mile Mountain, have shale or shaly sandstone roofs, and would have to be deep-mined. The seams are located in the middle of the formation which is about 140 feet thick.

The Lower coal zone is found in the lower 500 feet of the Straight Cliffs Formation and is exemplified by spotty thin seams. They seem to become more abundant in the western part of the area.

The Christensen zone is the most valuable of all the coal zones in the Escalante area. It is well developed in almost all parts of the area, except perhaps in the Upper Valley and Griffin Point quadrangles and in the extreme northern part of Canaan Creek quadrangle. In that part of the Escalante area the seams are more

lenticular and in places the zone does not have seams of mineable thickness. The zone improves to the west and south where often there are several very thick seams. This is especially evident in Death Ridge and Carcass Canyon quadrangles where seams more than 25 feet thick have been discovered. These thick coal beds often have considerable separation. In the extreme western part of the Carcass Canyon quadrangle the Christensen zone pinches out as lagoonal facies are supplanted by beach and near shore sands. The western limit of coal is found two or three miles east of the plateau front near the mouths of Right and Left Hand Collet Canyons.

The roof rock varies from place to place in a manner such that no areal generalizations can be made. For example the Shurtz and Schow mines are located less than 1,000 feet from each other and are opened on the same coal bed. The Schow mine has a sandstone roof and the Shurtz mine has a shale roof.

In general the Christensen zone is very dependable except for the areas previously excluded. The coal thins and thickens, splits appear and disappear, seams are replaced by others but in any one area there is nearly always a coal bed of mineable thickness. The Christensen coal zone is located between 550 and 650 feet above the base of the Straight Cliffs Formation in the Escalante area. The outcrops are mostly located along the walls or at the bottom of deep canyons so that in most cases deep mining will be necessary to extract the coal. The coal beds in zones above the Christensen

will also crop out in the walls of the canyons and again in most cases exploitation of those seams will necessitate deep mining.

The Rees coal zone lies interbedded in cliff-forming sandstones between the Christensen and Alvey zones. The thickness of strata involved is about 250-300 feet. The coal beds in this zone are very spotty and irregularly spaced in this column, often widely spaced. In some sections there are thick seams and in others there is no coal at all. The better localities are found at the west part of the area in the Griffin Point and Upper Valley quadrangles where there are usually at least two beds in a locality. The zone disappears completely along the Fifty-mile Mountain front to the east. The zone is generally unreliable and local areas will have to be thoroughly explored in order to fully delineate the extent of a mineable area.

The uppermost coal-bearing strata include the Alvey zones. The Alvey coal zone is located about 950 feet above the base of the Straight Cliffs Formation. The upper Alvey zone, where present, is found up to an additional 100 feet higher in the section. The Alvey zone is present in all quadrangles but thins and becomes poor in the eastern part of the Carcass Canyon quadrangle. The Alvey zone, like the Christensen, is lenticular, but reliable in continuously having at least one seam of mineable thickness. Seams up to 20 feet thick have been discovered. In the northwestern part of the Escalante area the upper Alvey zone has thick seams, but in general are not as good as those of the Alvey. The best location are in the Griffin Point quadrangle where coal beds greater than 11 feet have been measured.

There are a few localities, such as in the northwestern parts of Canaan Creek and Carcass Canyon quadrangles, where the Alvey coal beds lie less than 200 feet below the surface of the plateau. More detailed mapping and surveying might reveal a few large areas where strip mining may be possible. In most cases, however, the Alvey beds will have to be deep-mined.

Natural burning of coal beds at the outcrop has been extensive in some areas especially in the upper coal zones. Griffin Point quadrangle and the Central core area of the Upper Valley anticline (Canaan Creek quadrangle) are the largest areas. Another extensive area is located in the Carcass Canyon quadrangle along Right Hand Collet Canyon. Even so the areas of naturally burned coal are not as extensive as those found in the Smokey Mountain area to the south.

All of the beds in each of the zones are controlled by the same structural elements. In most areas of the Kaiparowits Plateau the coal undulates in gentle folds that will not present difficulty to mining. Here and there, however, a flexure is found with monoclinal proportions. The steep west flank of the Upper Valley anticline dips moderately (12-15 degrees) to the west burying the coal rapidly. This structure marks the west limit of the Escalante area. The area is mostly devoid of faults and the few present (except for the two northeast trending faults in Griffin Point quadrangle) are insignificant and should prove no hindrance to mining.

Over 100 analyses are available for the Kaiparowits Plateau coal field. The rank ranges from sub-bituminous C to high-volatile bituminous A. In general the ash content is moderate to high and the sulfur content low to moderate as mined.

### RANGE OF ANALYSES OF KAIPAROWITS COAL

| | Range | Average | No. analyses |
|---|---|---|---|
| Moisture | 3.60-28.70% | 12.68% | 94 as received |
| Volatile Matter | 21.92-57.49% | 44.33% | 111 dry |
| Fixed Carbon | 22.81-63.59% | 46.60% | 111 dry |
| Ash | 3.60-33.03% | 9.06% | 112 dry |
| Sulfur | 0.42- 3.40% | 1.09% | 75 dry |
| Btu/lb. | 8,499-14,236 | 11,712 | 108 dry |

The coal has no coking properties and would require mechanical cleaning in most areas to insure a satisfactory fuel for power production or as a source of solid hydrocarbons for conversion to other forms of fuel. Rank and other constitutents of the analyses vary from area to area.

### RANGE OF ANALYSES OF SMOKEY MOUNTAIN AREA COAL

| | Range | Average | No. analyses |
|---|---|---|---|
| Moisture | 3.70-24.20% | 10.61% | 24 as received |
| Volatile Matter | 21.92-57.38% | 42.39% | 38 dry |
| Fixed Carbon | 22.81-71.51% | 49.08% | 38 dry |
| Ash | 3.60-19.80% | 8.53% | 38 dry |
| Sulfur | 0.44- 1.50% | 1.03% | 38 dry |
| Btu/lb. | 10,736-13,746 | 12,145 | 38 dry |

## RANGE OF ANALYSES OF ESCALANTE AREA COAL

| | Range | Average | No. analyses |
|---|---|---|---|
| Moisture | 3.60-24.80% | 10.51% | 40 as received |
| Volatile Matter | 37.47-57.49% | 45.39% | 53 dry |
| Fixed Carbon | 38.49-53.59% | 46.81% | 53 dry |
| Ash | 3.38-24.89% | 7.80% | 54 dry |
| Sulfur | 0.42-3.40 % | 1.26% | 24 dry |
| Btu/lb. | 8,499-14,236 | 11,563 | 53 dry |

## RANGE OF ANALYSES OF TROPIC AREA COAL

| | Range | Average | No. analyses |
|---|---|---|---|
| Moisture | 9.36-28.70 | 19.50% | 20 as received |
| Volatile Matter | 35.73-48.03 | 44.42% | 20 dry |
| Fixed carbon | 81.23-47.07 | 41.81% | 20 dry |
| Ash | 7.71-33.03 | 13.77% | 20 dry |
| Sulfur | 0.60-1.73 | 0.98% | 14 dry |
| Btu/lb. | 8,826-12,699 | 11,207 | 17 dry |

About three-quarters of the analyses are from surface outcrops or from the old mines. Most are channel samples, a few are grab samples. In the Smokey Mountain area the Btu/lb. value is a trifle higher inasmuch as most of the analyses were made of the Christensen coal zone, the deepest of the more valuable zones. Coal in the Christensen zone of the Escalante area is comparable, Alv ey coals run an average of 500 to 1,000 Btu/lb. less. However, the lowest heat value is from the Tropic area in the Christensen (Henderson) zone where it contains more moisture and ash.

Moisture is highest in the Tropic area, the other two have approximately equal values. In the Escalante area the coal becomes more moist west of the Upper Valley anticline. It is not known whether adequate precautions were taken in some of the sampling procedures to protect them from the moisture before testing.

The highest figures for volatile matter and the lowest ash content was highest in the Tropic area and was lowest in fixed carbon.

Sulfur content was highest in the Escalante area but it is felt that it is not a true indication for the area. Several high sulfur analyses were obtained from one mine (Schow mine) that affected the average figure. It is believed that the figure is more like that for the Tropic area which had the lowest sulfur content. The sulfur averages shown in the tables above were all calculated on a dry basis. A very low sulfur analysis from the Escalante area is the only one available for breakdown into forms of sulfur. It was taken at the Alvey mine in 1945 and classed as subbituminous B.

## G. Land Ownership

The land and minerals of the Kaiparowits Plateau coal field are owned by the U.S. Government and the State of Utah in a proportion of approximately 10 to 1. Land holdings by corporations and individuals are in the form of Federal leases and permits and State of Utah leases. Federal leases are distinguished from permits in that the former are obtained by competitive bidding by qualified persons and allow the lessor to mine or hold without mining designated lands for a 20-year renewable period. Payments are made (after the initial "bonus payment") for tons of coal mined and sold or for annual rental if no coal, or less than a stipulated minimum, is mined. A permit holder may prospect or mine from his lands for a period of 2 years. The permit may be extended for 2 years by continuing to pay an annual rental and agreeing to perform certain exploration work during the renewal period. This work customarily consists of drilling, one hole in each square mile of the land. This permit may be converted to a lease without competitive bidding at any time during its life after the land has been proved to contain mineable coal.

COAL LAND HOLDINGS IN THE KAIPAROWITS PLATEAU COAL FIELD (1970)

| Name | State of Utah Leases, Acres | Federal Leases or Permits, Acres | Total Acres |
|---|---|---|---|
| 1. Armstrong, D. E. | 840.00 | --- | 840.00 |
| 2. Atlantic-Richfield | 14,163.72 | 25,738.72 | 39,902.44 |
| 3. Bryce Canyon Coal & Coke | --- | 40.00 | 40.00 |
| 4. Consolidation Coal | --- | 25,533.41 | 25,533.41 |
| 5. Danklef, M. | --- | 1,093.34 | 1,093.34 |
| 6. Davies, B. | 40.00 | --- | 40.00 |
| 7. Delcoal, Inc. | 3,200.00 | 15,929.53 | 19,129.53 |
| 8. Dev. & Resources Co. | 1,280.00 | --- | 1,280.00 |
| 9. Fallick, M. L. | 960.00 | --- | 960.00 |
| 10. Frandsen, G. H. | --- | 160.00 | 160.00 |
| 11. Healy, R. L. | 803.95 | --- | 803.95 |
| 12. Hiko Bell Mng. & Oil | 1,280.00 | 1,040.00 | 2,320.00 |
| 13. Hollberg, R. J. | 3,797.88 | --- | 3,797.88 |
| 14. Knight, J. H. | 160.00 | 12,904.75 | 13,064.75 |
| 15. Peabody Coal Co. | 1,280.72 | 28,084.72 | 29,365.44 |
| 16. Phillips, J. W. | 160.00 | --- | 160.00 |
| 17. Rasmussen, W. L. | 1,919.96 | 8,774.72 | 10,694.68 |
| 18. Resources Co. | 6,210.44 | 39,355.19 | 45,565.63 |
| 19. Sentry Royalty Co. | 1,280.72 | --- | 1,280.72 |
| 20. Shakespear, A. | --- | 80.00 | 80.00 |
| 21. Sun Oil Co. | 4,511.60 | 21,711.00 | 26,222.60 |
| 22. West, S.H. | --- | 960.88 | 960.88 |
| 23. Woods Petroleum Co. | --- | 14,249.05 | 14,249.05 |
| Grand Totals | 41,888.99 | 195,655.31 | 237,544.30 |

## H. WATER RESOURCES OF THE KAIPAROWITS

Water resources in the Kaiparowits Plateau region are important because of their necessity in power generation, use in possible coal pipelines, and needed domestic supply in support of mining. Precipitation, the ultimate source of all water in an area, is extremely limited in the Kaiparowits region. Though as much as 30-40 inches per year may fall on isolated peaks or other high places around the plateau, the average is about 10 inches per year for the Kaiparowits. Some parts of the area, specifically in the south near Lake Powell, get as little as 6 and 7 inches of rain per year.

Lack of rain and the hot dry climate are not conditions which produce much surface water. Evaporation takes place at a much greater rate than precipitation. Streams and creeks on the plateau are mainly dry with the exception of some northern drainages a few of which traverse through the southern areas. During the summer spotty thunderstorms strike the Kaiparowits causing the dry creek beds to become swollen with water for a short period of time. In times of flood the major streams overflow their banks and cause extensive erosion. This water quickly dissipates flowing to Lake Powell where it discharges the muddy water. One of the largest continuous sources of surface water is the Escalante River which has an average annual flow of 3,500 acre feet near the town of Escalante. The river is found northeast of the plateau where sev eral perennial

streams join at approximately 5,500 feet elevation. At the mouth of the Escalante River the discharge in exceptional years exceeds 60,000 acre feet. The Escalante River flows into Lake Powell.

Many small creeks head on the Table Cliff and Aquarius Plateaus. Those adding to the flow of the Escalante River are retained in the Wide Hollow Reservoir. Their total discharge is about 8,000 acre feet per year and is used for irrigation and domestic purposes by the communities in Escalante Valley. Other such streams flow directly into the river between Escalante and Lake Powell. The Paria River on the southwestern limits of the plateau is estimated to have an annual flow of a little less than 3,500 acre feet for the Escalante River near the town of Escalante.

In the central part of the plateau many drainages, confined by the structure, empty southward into the Colorado River. As has been pointed out, they are usually dry, except in times of heavy rain when flash floods fill their banks, but here and there a small spring initiates a trickle of water which follows the stream bed until it is again consumed by the earth or dried up by the sun. A notable example is Last Chance Creek which is a source of emergency water for the thirsty traveler. In all, the surface water coming into the area is appropriated where possible. The principal reservoirs that store water in the Escalante area retain about 5,400 acre feet of water.

In the Tropic area the storage of water is considerably less. Many small "water keeps" are constructed by the ranchers to control flash floods and provide water for stock.

It is estimated by Resources Co. that 102,000 acre feet per year of water will be required to service a 5,000 mw power plant in the Kaiparowits area. This quantity of water is obviously not available from the streams and rivers of the Kaiparowits region. Two sources remain left to us: the ground water and Lake Powell. A smaller electric generating plant might draw from the lower Escalante River.

The Colorado River discharges over 7 million cubic feet per second of water a day into Lake Powell at Hite during peak run-off (U.S. Geological Survey Prof. Paper 442, p. 106). Of the stored water in Lake Powell, Utah's quota is limited to about 1.75 million acre feet a year. In September of 1965, the state of Utah allocated the water necessary for the proposed power plant of Resources Co. A contract with the U.S. Bureau of Reclamation has been made to establish the rights of Resources Co. to take this water out of Lake Powell. Hence, the water problem would seem solved but not so. Other power plants have been suggested, utilizing the Kaiparowits coal, which will also need large quantities of water.

Underground aquifers are a potential source of water in the Kaiparowits region which have as yet not been tapped. Ample

water is thought to be present in the central basin of the plateau owing to the large closed structure that it is. The northern part of the basin, closed on all sides, is 1,600 structural feet deep. South of this the basin becomes shallow and wide but retains its closure. Rock units which are known to be good aquifers in the area are the Navajo and Entrada Sandstones which are nearly 8,000 feet below the surface in the central basin but at or near the surface to the east and west of the plateau.

Some water may also be available in the Wahweap, Straight Cliffs, and Dakota sands, but the lenticular nature of the strata will probably limit the amount.

Oil wells drilled in various places on the plateau have encountered large amounts of water at certain horizons but an estimate of the total amount trapped in the basin is impossible. An artesian well in Last Chance Creek drilled for agriculture purposes discharges around 10 gallons per minute. Underground water outside the borders of the plateau has been discussed by Goode (1965). He estimated that, in the Navajo Sandstone alone, 50,000 to 60,000 acre feet of water per square mile is possible if the structure is right and saturation exists.

Analyses of the water varies from place to place but in general it is good. Due to the passage of water through coal, carbonaceous zones and shales in the Straight Cliffs Formation, the water is

sometimes extremely distasteful. Dissolved solids get higher than 1,000 ppm and the water contains much sulfate. It may be that water found deep within the structural basin in aeolian aquifers is of a better quality than the ground water which is less mobile in the lenticular fluvial sands. Additional supplies of water in the Kaiparowits area may be obtained by reducing the outflow from the plateau with channels and dams.

## I. ECONOMIC CONSIDERATIONS AND FORECAST

As previously stated the nature of occurrence of coal in the Kaiparowits Plateau coal field indicates that most must be exploited by underground mining methods. Although vast resources of recoverable coal are indicated and inferred, it will require much more detailed exploration, i.e., drilling, before any large scale mines can be planned and started. At this point in time (1970) it appears likely that a number of moderate-sized mines will be required to supply a single large market (1-2 million tons per year or more).

U.S. Bureau of mines authorities have estimated that employing modern mining methods in the Kaiparowits field will yield coal at roughly one dollar more per ton than similarly equipped and planned mines in the eastern and midcontinent underground operations. With what is known of general conditions in the Kaiparowits field, this seems to be a reasonable assumption. However, the base cost of three dollars per ton for mining coal in the eastern fields suggested by the same authorities may be

low, especially in light of new health and safety regulations to which mines must now comply. A more realistic figure under present conditions for the cost of mining in the Kaiparowits field would be nearer $4.50 per ton to which the cost of cleaning and transportation to a nearby point of utilization would add another $0.75, or a total of $5.25 per ton delivered to a nearby point; this is approximately 23¢ per million BTU on the basis of 11,500 Btu/lb. coal.

The Kaiparowits Plateau coal field has been and remains perhaps the least-known sizable coal reserve in the continental United States. This is the result of its remoteness and difficulty of access. Population density in the immediate vicinity is insignificant. Kane and Garfield Counties, Utah, and adjoining Coconino County, Arizona (northern part) have a combined population of less than 10,000. Its growth potential is not impressive. At the same time there is pressure from conservation groups to maintain the remote status of the region. They protest that the area contains scenic and natural wonders that should be preserved in their pristine state. These groups wish to set aside hugh tracts of land, some larger than the smaller of the New England States, into wilderness and recreation areas. Roadways into the area are protested, as well as other efforts to develop the area.

TP
Biased

On the other hand, the southwestern and intermountain areas are growing and their use of power, as elsewhere, is expected to

increase at a greater rate than population growth. Coal is expected to and must assume a larger share in providing the energy requirements for the future and, in fact, is already beginning to do so. It is forecast that coal will provide in the order of 28 to 30% of the energy for power production in the western U.S.A. by the year 2,000. In 1960 it provided less than 1% of the power generated west of the Continental Divide. In terms of coal this is estimated to be in excess of 156 million tons, roughly 300 times the amount of coal used for power production in the entire west in 1960.

The point of major use of energy in the southwestern U.S.A. is located 400 miles from the Kaiparowits plateau coal field in the vicinity of Los Angeles. Coal may be burned for its energy release close to the source of coal and the power resulting delivered by long lines to a load center, or coal may be transported to the same point for conversion there. In any event the energy must travel 400 miles; thus transportation is an important factor. Competitors to the Kaiparowits coal include the San Juan Basin of New Mexico and the Black Mesa Basin of Arizona. Both these areas have or will be strip-mined and thus have a decided advantage with respect to mining costs. The coal from these areas, however, generally has a lower heat value and is further from the market. Water availability for power generation is another factor which will pose problems in the Kaiparowits area and these problems are discussed in the

water resources section.

At present natural gas used for power generation in the Los Angeles area costs about 35¢ per million Btus. Transportation of electric energy by 500 KV lines from the Kaiparowits area is estimated to cost 18 to 21¢ per million Btus. Delivery of coal by pipeline may cost from 8 to 15¢ per million Btus, by unit train (if a railway can be constructed) 7 to 14¢ per million Btus. At least part of the transport must be by transmission lines because of stringent anti-pollution laws in California discouraging the construction of generating plants near the population centers. Assuming coal cost at 23¢ per million Btus, the competitive position of Kaiparowits coal takes the following form:

Energy Delivered to Los Angeles Area
Cost per million Btus

| | |
|---|---|
| Natural gas | 35¢ |
| By electric power trnsmission | 41 - 44¢ |
| By coal pipeline | 31 - 38¢ |
| By unit train | 30 - 37¢ |

This suggests that coal from the Kaiparowits Plateau coal field may be nearly competitive in the energy market at present. At least one of the coal land holders has disclosed plans of erecting an electric power generating plant near the coal and rumors indicate two more possibilities are being investigated by others. Two would be located in the Smokey Mountain area,

the third in the Escalante area. However, it should be made clear, that these companies indicate that many more definitve studies must be made and based on data not yet available before conclusive action will be taken.

Resources Co. (Arizona Public Service Co., San Diego Gas & Electric Co., and Southern California Edison Co.) has planned a steam power-generation plant to be built in Section 12, T. 43 S., R. 3 E., in the Warm Creek-Wahweap Creek area. Construction of an initial 650,000 kilowatt section will be built soon after 1970 and will use 2.2 million tons of coal annually. The entire plan calls for a $500 million plant with a capacity to generate 5 million kilowatts using 14.6 million tons of coal annually.

Conversion of coal to liquid and gas hold promise for requiting large amounts of coal. Technology for such processes are well advanced but are not yet competitive with natural gas and petroleum. Improved economy of conversion together with rising cost of natural gas and petroleum products is expected to result ultimately in the use of coal for the production of gas and liquid fuels. Utah has exceedingly large deposits of bituminous sandstones and oil shale that might prove competitive to coal even though the high-volatile coal of the Kaiparowits would be well-suited for the purpose. The long-range market schedule for Kaiparowits coal for this purpose appears promising, but no reliable time-schedule can be offered where so many variables exist.

Other uses or market to which Kaiparowits coal may be assigned are speculative. The quality of the coal excludes its use as a metallurgical fuel. The lack of railroad facilities greatly hamper its being considered as an item of export, although the construction of a coal pipeline might solve the problem.

In summary, it is difficult to assume that such a large reserve of coal will be entirely neglected in the light of dwindling energy resources and increased demands. It seems inevitable that the field will become an important contributor to the energy market of the southwestern U.S.A. but when and to what extent is dependent upon the acquisition of much more information, upon the success or failure of conservation-preservation groups to delay developments, by water availability, and upon the rate of technological advances in mining or in cutting the cost of neclear power generation or in producing energy by other means. If conditions are favorable it should take until 1975, as a minimum, before a power plant is put into operation. It is expected, however, that at least one will be functioning by 1980. Mining to supply gasification or liquefaction plants will probably occur at a much later date.

the third in the Kasalimana area. However, we should make [illegible] clear, that these comparisons indicate that many more [illegible] studies must be made and based [illegible]

Other ways to assess [illegible]

In summary, [illegible]

[illegible] 1980. [illegible]

## IV. Carcass Canyon
## Quadrangle Area

# IV. CARCASS CANYON QUADRANGLE AREA

## LOCATION, GEOGRAPHY, AND ACCESSIBILITY (See Map 1)

The Carcass Canyon quadrangle is located along the east side of the Kaiparowits Plateau and is a part of the Escalante area. The northeast corner marks the end of the Plateau proper that is topographically bounded by the nearly 1,000-foot escarpment of the Straight Cliffs. Accessibility is from Escalante (about 12 miles to the north edge of the map) along the Alvey Wash road. This road forks at Little Valley, the woutheast trending branch giving access to the west side of the quadrangle. Limited access to the remainder of the area is given by poor jeep-type roads present at the tops of benches between the canyons.

Physically the area is an undulating bench deeply cut by many canyons. These are mainly tributaries of Right Hand Collet Canyon, the only exception being Willard Canyon (tributary to Left Hand Collet Canyon) to the southeast. The Right Hand tributaries join along the east central edge of the map and radiate northerly and westerly like the branches of a tree.

## STRATIGRAPHY

Exposures of Cretaceous beds dominate, the only exceptions being a few small patches of Jurassic Morrison Formation below the Straight Cliffs at the extreme northeast corner of the map and a large patch of Quaternary alluv ium along Alvey Wash at the northwest corner. The bedrock formations, in ascending

order include the aforementioned Morrison Formation and the Dakota Formation, Tropic Shale, Straight Cliffs Formation, and the Wahweap Formation. Only the upper conglomeratic sandstone of the Morrison is exposed.

Immediately overlying the Morrison is the initial Cretaceous unit, the Dakota, approximately 140 feet thick.

It is not believed that the coal of the Dakota Formation in this quadrangle is commercial and no coal seams have been mapped.

Above the Dakota is the Tropic Shale, about 700 feet thick. The unit is dominated by olive-gray shale. Toward the top some fine-grained grayish-orange sandstone beds make their appearance. Thin beds of bentonite and limestone concretions are found near the base. The Tropic Shale contains coal in the western part of the Kaiparowits Field, no significant coal has been discovered in this area.

The Straight Cliffs Formation is the important coal-bearing unit of the Carcass Canyon area. Most of the outcrop area exhibits the formation even though much of the western bench area is covered by a veneer of Wahweap. The Straight Cliffs has not been subdivided by investigators but all four members are recognizable. The unit is at least 1,300 feet thick and may be as much as 1,500 feet thick. The unit is divisible into three parts, a lower unit about 600 feet thick, a middle unit of about the same

thickness, and upper unit 100-300 feet thick. The lower unit has been subdivided in other parts of the Plateau into the Tibbet Canyon Member (lower 160 feet) and the Smokey Hollow Member. Both units consist of alternating beds of massive sandstone, shaly sandstone, and medium to thickbedded sandstone of white, yellow, tan, or brown color. the sands are fine-to-coarse-grained, crossbedded, and friable. At times a gray shale, a thin coal seam or a bed of conglomerate interrupts the sequence of resistant sandstones. The middel 600 feet, the John Henry Member, is the coal-bearing unit. It is a slope-former consisting of gray shale, carbonaceous shale, shaly sandstone, coal, and some massive or thick-bedded sandstones. The lower 200 feet of this member contain mainly the softer shaly strata and the Christensen coal zone. The more massive and resistant sandstone beds occupy the middle 200 feet. The Rees coal zone, where represented, has coal interbedded in these sandstones. the upper 200 feet again is characterized by shales and coals of the Alvey zone. The upper part of the Formation has been designated the Drip Tank Member in other areas of the Plateau. It is similar in appearance to the lower 600 feet. It forms a resistant caprock on most of the benches, but is eroded from the northeastern outcrops.

The cliffs along the western edge of the map are made up of the Wahweap Formation. The unit is at least 1,000 feet thick, but only the lower 700 feet are present. The lower 500 feet is

slopeforming consisting of gray mudstones, claystones, and subordinate gray-orange sandstone. The upper part of the formation is more resistant and contains a greater number of thick yellow-gray sandstone beds.

The alluvium in Alvey Wash consists of stratified sand, silt, and gravel. Some unsorted flash flood deposits are also present.

## STRUCTURE

The strata of the Carcass Canyon area lie as an undulating surface that is reflected by the Plateau surface. Two ill-defined structural axes, probably extension of the Croton syncline and the Rees anticline cut across the quadrangle in a crude north-south direction. Dips are gentle (less than 5 degrees) in most areas except along the Straight Cliffs escarpment where they might be described as moderate (7 to 10 degrees). No important faulting was found anywhere in the area.

## PROPERTY CONTROL

Ownership of lands in the Carcass Canyon quadrangle as of January 1, 1970 was as follows:

| | |
|---|---|
| Bureau of Land Management | 89.2% |
| State Lands | 9.6% |
| Private Lands | 1.2% |

Of these lands 48.5% were under lease or prospecting permit for coal. The unleased areas are located in the northeast part of

the quadrangle where most of the outcrops are located and where accessibility is possible only on foot or horseback. Permits and leases are controlled as follows:

| | |
|---|---|
| Consolidation Coal Company leases | 14.7% |
| W. L. Rasmussen permits | 12.9% |
| W. L. Rasmussen leases | 1.9% |
| Delcoal Company permits | 12.5% |
| Delcoal Comapny leases | 1.7% |
| Development Resources Company leases | 2.5% |
| Jesse Knight leases | 1.1% |
| G. H. Frandsen leases | 0.8% |
| Bryce Canyon Coal and Coke Co. leases | 0.4% |
| Unleased/no permits | 51.5% |
| | 100.0% |

## COAL

### A. Surface Information

There are 158 sections of measured coal available for the Carcass Canyon quadroangle. Coal is present in at least four coal zones, three have economic potential.

The Alvey coal zone is well developed over much of the quadrangle. The seams are poor and thin in the eastern part. In these less desirable localities, near the escarpment, the strata of the Alvey zone become sandy supplanting many of the shale and coal beds. Seventy-seven sections indicate coal in one or more seams with individual seams up to 16.5 feet thick.

The coal is lenticular, but other than the poor area of the quadrangle already discussed coal seams over four feet thick are nearly everywhere present.

The Rees Coal zone is developed through the central part of the quadrangle. The coal is highly lenticular and normally in thicknesses less than four feet. In a few places, however, small blocks of coal would be available. There seems to be an axis of thickening extending from Section 9 to Section 36 in T. 37 S., R. 3 E. The thickest coal seam measured was 6.6 feet.

The most valuable coal zone is the Christensen where most often there are two mineable seams present. One area of exception lies in a 2-mile strip along the east edge of the map north of Carcass Canyon. Again marine sands replace many of the lagoonal clays, muds and coals. The seams should be between 4 and 10 feet over the remainder of the quadrangle. The thickest seam measured is 11 feet, another is 13.5 feet with a 0.5-foot split in the upper third. The lower coal zones are not economic, the seams ranging between 1 and 2 feet in thickness. A large burned area has been noted by Doelling (1968) centered around Right Hand Collet Canyon in the middle of the map area. Most of the Straight Cliffs Formation here has been heavily clinkered and would indicate that the seams present were thick.

## B. Subsurface Information

No drill-hole information is available for this quadrangle.

The Alvey coal should be less than 1,000 feet below the surface everywhere over the map area. The Christensen zone may be 1,300 feet below the surface underneath the Wahweap buttes located along the west edge of the quadrangle. Everywhere else depths to the seams should be less than 1,000 feet.

## C. Quality of Coal

Fourteen proximate analyses are available on a dry basis. Calorific values are mostly between 10,000 and 11,000 Btu/lb., fixed carbon range from 38.8 to 51.7%, volatile matter from 42.0 to 50.5% and ash from 3.7 to 13.5%. The average ash content for both the Alvey and Christensen zones is 7.5%. No data on sulfur is available. The calorific value of the Christensen seams average a little higher than that for the Alvey zone.

## D. Mines and Development

There are no mines or prospects known to exist in the Carcass Canyon quadrangle.

COAL RESERVES IN SHORT TONS

| COAL ZONE | Class II | Class III | Total |
|---|---|---|---|
| Alvey | 168,809,191 | 37,481,638 | 206,290,829 |
| Rees | 6,306,319 | --- | 6,306,319 |
| Christensen | 258,828,103 | 157,557,141 | 416,385,244 |
| Totals | 433,943,613 | 195,038,779 | 628,982,392 |

(Mineable coal will be between 33 and 50% of above amounts).

# V. Analysis

## V. Analysis

A. Every effort should be made to protect what is still a wild and scenic environment upon Fifty Mile Mountain and along the Alvey Wash, Garfield County roadway. This road not only meanders through the breaks above the Escalante desert but will undoubtedly eventually evolve into a major recreation industrial road system. The present road currently provides legal access for public lands to the southwest including the Upper Valley oil field. It was located where it is due to topography, while the extreme landscape of the bordering area suggests that it will continue to be a main transportation artery into the future, expecially with continued oil and coal exploration activity. (See overlays).

B. A ten thousand dollar ($10,000) performance bond shall be required in order to quarantee site protection, reclamation, removal of all litter, and compliance with all terms of the permit/lease. The bond shall be released by the District Manager following termination and satisfactory compliance with the terms of the permit/lease.

The VI Reclamation and Surface Protection Stipulations encompass not only exploration but eventual lease mining. Should the subject lands to leasehold, additional use and protection measures will be needed once mining plans and techniques become known.

C. Monumental challenges exist upon the steep slopes of not only the Collett's tributaries but also the Alvey Wash headwaters

relative to watershed protection. The cretacious, mudstone soils are excessively frail. Seasonal summer rains are violent. Flooding and excessive topographic alterations result from these thunderstorms. Much of the area has been identified for restricted use (see overlay) in the Escalante MFP. Downstream flooding and siltation of agricultural lands near Escalante occur each summer. Accordingly, any future land use in these zones needs to come as a result of extensive prior planning and be under close environmental protection scrutiny during the operation. The Alvey Wash watershed is of primary management concern to BLM (See Soil & Watershed MFP overlay).

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

# *Memorandum*

3500
P-4

**TO** : Delcoal Prospecting Permit File
Utah 1375-5233-5234-5235 and 7276

**DATE:** February 19, 1971

**FROM** : Area Manager, Escalante

**SUBJECT:** Anticipated Exploration or Mining Methods and Plans for Affected Land and Environs

Anticipated exploration methods will mainly be confined to core drilling. This requires access roads into all corners of the permit area. The roads need not be high standard roads requiring extensive landscape shaping, but can be confined to provide suitable access for the machinery needed in the drilling operations. Many of the access roads can be placed in the bottom of washes, which has no affect on watershed or scenic values. Other access roads will have to be constructed on side hills and mesa tops, which will require some surface disturbance. This disturbance can be minimized through selective road location where they can be reclaimed or upgraded to meet the desired need. The affected area will have little conflict on other uses except recreational sight seeing which is not high in the area involved.

It is recommended that where Delcoal access needs conform to BLM needs as cited upon Maps 3 thru 7, the proposed roads be constructed to BLM standards along routes approved in advance by the district office.

Harold W. Lamb

Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan

5010-108

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

# *Memorandum*

3500
P-4

**TO** : Delcoal Prospecting Permit File
Utah 1375-5233-5234-5235 and 7276

**DATE:** February 19, 1971

**FROM** : Area Manager, Escalante

**SUBJECT:** Public Health and Safety

In discussing the type of coal found in this region and the extracting methods with the USGS, the following public health and safety consideration will result.

1. Toxic Material - The coal found throughout the permit area is deposited in basic rather than acidic formations. This type of deposition causes the coal to be basic in nature, which is non toxic to animal life.

2. Fire Hazards - Fire throughout a mining operation is always probable; therefore, air vents and other precautions will have to be taken. If fire is started it would have little effect on the surface because of the limited burning fuels. Underground fires in the coal could cause surface sloughing, but fires from mining operations are rare and can be controlled and extinguished.

3. Landslide Potential - Landslides in the area are confined to small areas with little danger to public safety. The formations have eroded to form talis slopes all down the canyon walls, which reduces landslide danger. In areas where the canyon walls are vertical, slides are evident. These derive from erosion of the shale and sandstone formation causing care to be taken in these areas.

4. Hazardous Exploration or Mine Workings - In areas where the coal tunnels will be abandoned, it will be necessary to seal all openings. This will include air vents and service shafts. Outside equipment such as belt elevators and other structures should be removed to provide safe conditions. Exploration drilling is plugged under requirements of USGS leaving no unusual hazards to man or animal.

5. Dust - Due to the abundance of oil and resins found in the coal, surface dust will be minimal. Dust problems will mainly be confined to the underground operations and have no effect on air pollution.

6. Flooding - Flash floods occur intermittently throughout the late summer and fall months. Flood danger is confined to the large drainages and caution should be taken to prevent damage or injury during the flood season. All development and mine entrances should be constructed with this hazard in mind.

*Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan*

Flood enhancement can occur if strict watershed controls are not practiced in road location and construction or with any type of excavation. Controls can be implemented to reduce runoff above what nature has provided, thus improving watershed conditions and lessening flood danger.

7. Waste Disposal - Waste from exploration drilling will not affect health standards. Waste from mining operations is less than hardrock mining, in that all the coal is removed from the site. If milling takes place in the vicinity of the mine, an estimated 5 to 20% of all the coal mined will be waste. This waste material should be disposed of through its use in watershed improvement. If the material has properties capable of growing vegetation, it should be landscaped to enhance both watershed and the scenery. The waste material as seen at this time from mining operations should not have any properties detrimental to public health and safety.

Harold W. Lamb

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6
UNITED STATES GOVERNMENT

# *Memorandum*

3500
P-4

**TO** : Delcoal Prospecting Permit File
Utah 1375, 5233, 5234, 5235, 5237 and 7276

**DATE:** February 19, 1971

**FROM** : Area Manager, Escalante

**SUBJECT:** Adjoining Land Uses

The prospecting permit area covers a portion of three grazing allotments which are presently being grazed by cattle each spring and summer. Zerconium prospecting claims are found in the canyons near the south end of the permit area. Little effort has been put forth to develop the finding, but future need may provide the means for extracting the material.

An oil field located approximately 5 miles west of the permit area is presently in production. The size of the field has not yet been determined, and could extend into the permit area. Oil exploration drilling has been done approximately 1 mile south of the permit area, but none has been done inside the area at the time of this writing.

The permit area covers a portion of the Alvey Wash drainage area that supplies irrigation water to several hundred acres in the valley below the town of Escalante. To improve the watershed conditions, anticipated watershed improvement practices have been scheduled for suitable sites throughout the watershed.

Harold W. Lamb

*Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan*

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

# *Memorandum*

TO : Stu Carlson - Team Leader DATE: February 17, 1971

FROM : District Recreation Specialist

SUBJECT: Technical Examinations

Delcoal Prospecting Permit Extensions (Utah 1375,5233-37, 7276)

Present Situation (General Area of Leases)

## Recreation

Presently this area does not receive heavy recreational use. There are no developed recreation sites, BLM or non-BLM within this general area. Althoug considered scenic, the subject area does not contain the qualities that does the surrounding attractions such as Lake Powell, Escalante Canyon, etc.

The major recreation activity drawing visitors to this area would be hunting mule deer in the fall of the year. The pinon and juniper plus the broken terrain offer good cover for this species. Huntable numbers have declined in past years as is indicated by the hunter success.

Other recreation pursuits include driving for pleasure in out of the way places, wildlife observation and photography.

## Archeological Values

Several storage cists, chipping sites and other evidences of early inhabitants exist in the general area. Five are indicated on the overlay and others are known to exist, although their specific location has not been identified. Much information is needed as to location, condition and importance (scientifi and interpretive) of these and other sites in the subject area.

## Timber

The subject area contains an occasional conifer (Ponderosa Pine and Douglas Fir) in the more protected areas. These are not present in sufficient quantities to support any commercial lumber operation, but are valuable for enhancement of the scenic qualities as well as cover for possible future recreation sites.

The area also contains a considerable cover of Pinon-Juniper. Some of this has been removed in the past by Range and Watershed Rehabilitation Projects. Present use of this resource has been limited to an occasional sale of posts to local ranchers and for wildlife cover. These species also add to the scenery.

5010-108

*Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan*

UNITED STATES GOVERNMENT

# Memorandum

TO : [illegible]

FROM : [illegible]

SUBJECT: Technical Considerations

[illegible]

[illegible]

Background

[illegible]

[illegible]

[illegible]

Jurisdictional Issues

[illegible]

Issues

[illegible]

[illegible]

## Environmental

Scenic classification of this area according to BLM 1605.47A1 (URA) would rate moderate. Present surface disturbances are limited to natural erosion due to flooding, range and watershed improvement projects (P-J Removal & water retention structures) and road construction. Present air quality is excellent being relatively free form pollutions both visual and otherwise. The area is remote and although not free wilderness, it does give the occasional visitor a feeling of solitude.

## Area Potential

### Recreation

Possible recreation developments may include:

1. Increased hunter days through upgrading of the existing wildlife habitat. This would not only include deer hunting, but increase in the waterfowl habitat through construction of water control structures is possible.

2. Construction of hunter camps.

3. Improved access including interpretive signing explaining the geology, history and multiple use aspects of the area.

4. Development of the more important archeological sites (importance yet to be determined.)

## Management & Development Recommendations

1. All surface disturbances and mining operations be kept out of view of major roads or made to be harmonious with the surrounding scenery.

2. All surface disturbances be revegetated with species providing feed for big game.

3. Prohibit cutting of conifers without permission.

4. All waste material from mining or exploratory work be kept out of drainages.

5. All areas of proposed development be investigated by trained archeologist prior to any disturbance or development.

6. All roads be located to have the least impact on the environment and best serve the public access needs.

7. All culinary water developments be made available for public use.
8. Hunter camps be constructed and located so as to draw hunters away from going mining operations.
9. Visual air pollution be kept below levels set by BLM. This includes dust from haul roads.

M. Scott Packer

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

# *Memorandum*

3500
P-4

TO : Stu Carlson - Team Leader

DATE: February 22, 1971

FROM : Range & Wildlife Specialist

SUBJECT: Technical Examination

## Delcoal Prospecting Permit Extensions

### Present situation

### Livestock Resource Values

### Allotments

The general area covered by the prospecting permits are included in portions of three allotments. Two of the three, Alvey Wash and Last Chance Allotments are under intensive management (AMPs) the third allotment, Collets, has limited qualities for good range conditions and is considered marginal for grazing purposes. Eventually the livestock use within the Collets Allotment will be transferred to other more productive areas. The licensees number of cattle grazed and season of use of the three allotments are:

Alvey Wash Allotment (Covering 80% of area)

| | | |
|---|---|---|
| J. C. Spencer | 114 Cattle | 6/16 to 9/30 |
| Beryl Shurtz | 90 Cattle | 5/16 to 9/30 |
| E. R. Shurtz | 214 Cattle | 5/16 to 9/30 |
| | 29 Cattle | 6/16 to 9/30 |

Last Chance Allotment (Covering 10% of area)

| | | |
|---|---|---|
| Verl and Robert Langston | 290 Cattle | 05/01 to 10/16 |

Collets Allotment (Covering 10% of area)

| | | |
|---|---|---|
| Darrell Alvey | 65 Cattle | 06/16 to 09/30 |
| S. J. and Sariah Alvey | 43 Cattle | 06/16 to 09/30 |

### Range Improvements

### Existing

The following range improvements were required to implement the Allotment Management Plan in order to achieve the objectives as set up in the Plan.

*Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan*

| Type | Number of Units |
|---|---|
| Chaining and/or plowing and Seeding | 2215 Acres |
| Fences | 5 Miles |
| Cattleguard | 3 Each |
| Reservoirs | 4 Each |
| Springs | 1 Each |
| Well | 1 Each |

### Proposed

Additional range improvements required to meet the ranchers Class I Demand.

| Type | Number of Units |
|---|---|
| Chaining and/or Plowing and Seeding | 2,500 Acres |
| Reservoirs | 10 Each |

### Potential

Increased AUMs are not required by present licensees to meet their Class I damand. AUMs could be used for watershed, wildlife and/or transferring of additional livestock from other less suitable areas.

| Type | Number of Units |
|---|---|
| Chaining and seeding | 1,000 Acres |

## Fisheries Resource Value

No significant fishing resources are within the area. However, if detention dams are constructed, provisions should be made for construction which will allow for the development of fisheries.

## Wildlife Resource Value

The Escalante River URA designates this area as a Mule Deer winter habitat. The main habitat is found in the breaks located in the pinon-juniper vegetative types with Bitterbrush and Cliffrose being the preferred winter foods. The deer migrate from the higher areas of Canaan Mountain to this area. At present the numbers of mule deer is considered to be way below potential. There are no known rare or endangered species of wildlife within the general area.

### Fire Consideration

During the past 15 years there has been only three fires reported in the Alvey Wash area. All three fires were caused by lightning striking a Juniper or Pinon tree. All three fires were Class A fires (less than ¼ acre). This low fire occurrence and acreage burned is due primarily to the sparse nature of the vegetation and remoteness of the area to human influence hazards. With the increased grass coverage as a result of the seeded areas, and the improvement of existing roads potential fire hazards will increase.

## Management and Development Recommendations

### Livestock

Gates be constructed or cattleguards be installed where new roads pass through fences. Gates must be closed at all times when livestock are grazing in the area.

BLM Standard roads be constructed to all proposed reservoir sites and into areas proposed for chaining as indicated on road access overlay.

Livestock in the area not be molested, and that disturbance of them be held to a minimum.

All waste material from mining or exploratory work be kept out of drainages and all water sources.

Any water impoundments constructed for mining or exploratory work be of a permanent nature and be made available for livestock use.

### Improvements

All water impoundments required as a result of mining activities be constructed to meet BLM specifications. Before construction BLM must be notified and a joint inspection be made to determine location.

Any access roads required in addition of present roads be approved by BLM in advance and be located and constructed to minimize soil erosion.

Any disturbances of reseeded areas be revegetated and brought back to original condition.

All other disturbances be seeded to native grass and browse to provide feed for big game.

BLM be informed of any drill holes where a potential for water development exist.

### Wildlife & Fisheries

If possible all major structures be constructed to enhance the development of fisheries and waterfowl habitat.

Browse species palatable to wildlife be planted in all disturbed areas.

Roads be constructed so as to allow hunter access in areas not previous accessible.

### Fire Hazard

Spark arrestors be installed on construction equipment to minimize the danger of man made fires.

Fire prevention posters be installed on all main roads leading into the area.

All slash material resulting from mining activities be piled and burned under close supervision during the off fire season.

J. Darwin Snell

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

# *Memorandum*

3500
P-4

TO : Delco Coal Leases Case File

DATE: February 23, 1971

FROM : District Engineer

SUBJECT: Watersheds

1. Erosion

Watershed conditions in the area covered by the proposed lease, as a whole, vary from poor over much of the area to good for those isolated benches having the deeper soils mantel. The area is one of a series of plateau surfaces which lies to the west of the Straight Cliffs and in the northern extention of the Kaiparowits Plateau. These series of isolated plateaus are separated by deeply cut canyons eroded into the sandstone and shales of the Straight Cliffs as spring run off and torrential summer rains flow to the lower elevations. These erosion patterns are due to both the lack of adequate vegetative covering and normal geologic erosion.

To combat erosion problems in the area, while bringing back a good vegetative cover, some of the plateaus with the deeper soil cover have been reseeded to wheat grass. These reseeding areas indicate that a fairly rapid recovery can be achieved over much of the area by a combination of natural and artificial revegetation. To aid in the protection of these seeded areas from erosion by the flooding and cutting of the small drainage ways through the seedings into deep walled gullies as they approach the deep canyons, small erosion control dams have been constructed. These not only aid in combating erosion but furnish stock water to the seedings.

2. Flooding

The area is characterized by heavy high run-offs during summer storms, of cloud burst intensities with heavy bed loads of silt and gravel being transported by all waterways. These sudden storms in the area, wash out those existing roads in the higher reaches and deposit fans and deltas of silt and gravel at the canyon mouths at the foot of the Straight Cliffs making it impossible to maintain roads or trails up these canyons to the higher reaches. Spring run-off, to an extent, aids in the erosion but it is usually of a gradual increasing flow and does not contribute greatly to the damage of the roads or seedings. Due to the magnitude of some storms in the area, roads lying to the east of the Straight Cliffs in the Escalante River area, are damaged by flows coming from the canyon in the Straight Cliffs.

3. Water Quality

The only perennial stream in the area is the Alvey Wash and the flow here is quite low in the late summer months. The quality of its waters in the

*Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan*

upper reaches is very good but as it flows down the canyon it becomes more alkaline but not to the extent it is unpalatable to stock. All other canyons and waterways flow only during storms and are lightly or heavily ladened with silt depending upon the intensity of the storm. These waters have not been tested but other waters in the same general area indicate low concentrations of soluable salts and other dissolved pollutants.

### 4. Water Quantity

The quantity of water for the area is dependent on the winter snows and sudden summer storms. All the stream channels, with the exception of the Alvey Wash are dry during the summer months following spring run-off. Exceptionial heavy floods have been experienced in the Alvey Wash and Right Hand Collets Canyon during the summer months. Alvey Wash channel is wide enough and of such a low slope that it can handle the flows with ease, but the Collets Canyon area is of such a steep slope, bare rock and narrow area that summer floods gut the canyon of any vegetation and soil build up that may occur during low flows between the heavy floods.

### 5. Control

Results obtained from the reseeded areas and the small silt detention structures constructed indicate that farily rapid recovery from erosion and silt control can be accomplished on these high isolated plateaus. Investigations of the reseeded area shows that nearly all erosion pattern, both sheet and gully, have been stopped by the heavy growth of grass in the reseeded areas and that the small silt detention structures are silting up the gullies leading into the seeded areas.

The reseeding of potential areas in the general area would aid in controlling the heavy run-off by summer storms in the canyons besecting the area. Additional silt control structures on these new areas and in Alvey Wash would be a big factor in erosion and silt control. The steep rocky canyons cutting through the Straight Cliffs can be controlled only through the revegetation and construction of silt control structures in the higher reaches of the area and this would be of a limited nature. Heavy storms located over the bare rock and steep slopes of side canyons leading to the main canyons would still contribute to heavy silt and gravel movement and erosion.

### 6. Access

Accessability into the area is from the town of Escalante to the north up the Alvey Wash. This road is a county maintained road up to the Little Valley junction. From this point a BLM road has been constructed and maintained into the area covered by the lease. This road was constructed for use by contractors constructing silt control structures, reseeding of the select plateau areas, stockman using the grazing allotments and for management of the area by BLM. This road was constructed from the junction in Little Valley to Airport Bench Junction to the south.

Due to the eroded, deeply cut canyons this road traverses the benches where possible and goes into dugway construction while traversing the canyons. The topography of the area is such that road construction is sparse and only a few

spurs to springs and seedings have been constructed as the areas have been developed. The area of lease can be reached by a rough jeep road that comes up the Straight Cliffs from the Escalante Deseret road and traverses Left Hand Colletts Canyon up to Airport Bench Junction. The portion of road in Colletts Canyon has been completely obliterated so many times that Kane County has abandoned this portion. At the present this road is barely passable. A tractor was taken up the canyon to aid in brush and seeding control on private holdings and during this trip tried to make the road passable.

All roads to be constructed in the area, in the future, for any development should be thouroughly planned, surveyed and constructed to add as little erosion as possible to the area. If the lease area is eventually developed it is strongly suggested that the road up Alvey Wash be used for access to the coal areas and for this road to be reconstructed on the east side of Alvey Wash up to Little Valley Junction. This relocation would do away with the continued maintenance problems after every storm. This road will not only be used by the lease in question, but by other coal leases, oil leases, ranchers and BLM management personnel making it quite an asset to the area. Future recreational areas could be planned in the area with an adequate road system.

The existing road is quite adequate for the use it was constructed for but to be used as a haul road for coal would have to be up graded to include additional culverts, bridges, straightening of some areas and new curves constructed.

If the coal leases are going to mine by convential shaft, tunnel methods, the coal could be brought to the top of the plateaus and placed in a central stockpile for hauling to point of consumption. Collection roads would then be necessary but could be adequately constructed on the fairly level areas of the benches and plateaus. We feel it is infeasable to try and construct roads in the canyon floors to take out the coal or to try to take the coal out to the south by the way of Airport Bench and Left Hand Colletts canyon as the road from the lease area to Airport Bench is quite rugged and chopped by numerous feeder canyons and Colletts Canyon would entail quite an expendenture of monies to construct. This route would be of little value to other future oil, gas and coal leases, ranchers and BLM personnel using and needing to get into the area.

gm Gaudie

| Section | Act | [illegible] | |
|---|---|---|---|
| D. MGR. | | | |
| ADM | | | |
| DRM | | | L |
| RS | | | |
| RAM 1 | | | |
| [illegible] | | | |
| [illegible] | | | |
| LANDS | | / | |
| REC | | | |
| FILE | | | |

FEB 23 1971

United States Department of the Interior

GEOLOGICAL SURVEY

Branch of Mining Operations
8432 Federal Building
125 South State Street
Salt Lake City, Utah, 84111

U-5233
U-5234
U-5235
U-5236
U-5237
U-1362
U-1363

February 18, 1971

Memorandum

To: Fred Howard, District Manager, BLM, Kanab, Utah
Attention: Garold W. Lamb

From: Deputy Regional Mining Supervisor

Subject: Delcoal prospecting and development program
Permits U-5233 through U-5237 and U-1362 and U-1363

As you are aware, Delcoal has drilled eight holes on the prospecting permits listed above. The holes were drilled through the upper Alvey Coal Zone and electric logs were completed and the holes are plugged. The holes were not deep enough to penetrate the lower Christensen Coal Zone. This drilling, one hole per permit, was required as minimum exploration for an extension past the primary term of the permits.

As a result of this drilling, possible minable coal in the Alvey Zone was encountered. To prove a valuable commercial deposit of coal additional drilling will be required. This drilling must establish the continuity of at least one coal bed of minable thickness. Probable mining conditions and the quality of the coal must also be determined. To obtain this information we believe a minimum of one drill hole per section will be required. About half of these must be drilled with water and cores recovered.

As to the surface disturbance relative to this prospecting, road work will be required to gain access to some of the required holes. Where possible these access roads will be along the valleys. Generally, the roads will skirt the valley floor and only where necessary will roads be built in areas of higher relief. Cut and fill will be held to an absolute minimum and road width will be the width of a bulldozer blade. Drill sites will be about 50 feet in diameter and located at the edge of valleys or on bedrock where alluvium is a minimum. No toxic materials should be released in drilling; however, some coal cuttings or drilling mud may spill in

the immediate vicinity of the drill site. Reseeding of the drill sites and roads can be completed by the end of the extended term of the permit--2 years.

Should a commercial deposit of coal be discovered and a market established, the property would probably be developed by two underground mines. The mines would have a capacity of at least 1 million tons each and mine mouth use or use in the vicinity would be probable because of the isolation of the area and the absence of rail transportation. There would be no surface mining.

The initial development would probably be in the northern part of the permit area. An inclined shaft, possibly located in permit U-5237, would be driven to develop the northern part of the reserve. A second mine would possibly be located in Right Hand Collet Canyon.

With the information now available it would be difficult to comment on the amount of waste generated in mining; however, there would be some carbonaceous shales and sandstone waste. An estimate would be from 5 to 15 percent of the total tonnage mined. It would probably be stored in one of the smaller ravines or canyons near the mine portal and should be located away from a major drainage channel.

The coal contains less than one percent sulphur and should water develop in the mines and require pumping, the acidity would be minimal and would soon be neutralized by the alkaline surface water or sediments of the area. This would be true also of any possible leaching from the waste dumps.

Since the sulphur content of the coal is low, any oxides of sulphur in the stack gasses of a power plant would also be low and should be controlled by current or future technology.

An analysis of a coal bed in the Alvey Zone mined on Federal lease SL-048223 north of the permit area is listed below:

| | | |
|---|---|---|
| Moisture | 20.4 | percent |
| Volatile Matter | 34.8 | " |
| Fixed Carbon | 36.9 | " |
| Ash | 7.9 | " |
| | 100.0 | " |
| Btu | 92,50 | |

When prospecting or mining plans are submitted by Delcoal we will contact you and then we can arrive at more specific details concerning surface disturbance.

J. W. Moffitt

J. W. Moffitt

cc:
Washington
Dan Jones, BLM, Salt Lake City
Gerald W. Lamb, BLM, Escalante

# VI. Reclamation & Surface Protection Stipulations

## VI. Reclamation & Surface Protection Stipulations

General - In order to control conditions causing or contributing to water pollution, soil erosion, hazards to health, safety and property damage, and for the conservation of the resources and the preservation of natural beauty, the permittee will design and perform all operations with a view to the prevention of pollution and erosion and so far as reasonably possible restore the public land to its former condition.

Stipulations - The following stipulations apply to the coal prospecting permit areas with certain other additional stipulations required for the actual mining operations.

### 1. Roads

The existing roads and natural channels are to be used to fullest extent possible for access to drill sites. The roads will be maintained in good condition at all times. Heavy use may require gravel capping of all or portions of these roads. Gravel of suitable quality is readily available.

Due to topography and high erosion hazards road extensions must be held to a minimum. All new roads will be located by the permittee and BLM. Certain of these roads will become a part of the permanent road system. These roads will be constructed to meet or exceed the single lane 12 foot surface width (Illustration 9113.12L), adequate ditching and culverts (Illustration 9113.33D), gravel capped and to meet other standards as designated by BLM. Other of these roads will be considered temporary, constructed to BLM minimum standards and upon completion

7

of their use they be restored to near normal conditions.

2. Drill Sites

The drill site is to be located in such a manner that erosion and total area of surface disturbance can be held to a minimum. The site is to be leveled. The top soil placed to one side with an excavated pit placed near the drill hole. The pit is to be of sufficient size to contain all by-products of the drilling operations. Upon completion of the drilling the materials within the pit will be dried and thoroughly mixed with other sub soil materials. Top soil will be placed back over the entire disturbed area and seeded to specifications.

3. Water Development

Water source(s) may be required to carry out the exploration/mining operations. It is required that permittee/lessee and BLM jointly determine the location and type of development to be made in accordance with BLM standards and multiple use management needs.

Adequate distribution and quantity of water is presently a management problem. It is requested that the permittee/lessee furnish timely information on depths of water and approximate quantity of water encountered in each of the drill holes. If a good source of water is encountered and determined by BLM to significient resource benefits that the hole will be temporarily capped until such time as it can be cased and developed.

4. Fences and Cattleguards

Fences, cattleguards and related structures or segments thereof may be required, as determined by BLM, in existing fences or new fences where exploration/mining in some way modifies livestock access or use patterns. All new fences and altered existing fences are to be maintained currently in good repair.

Specifications for new construction are attached, Forms: 9172-29, 9172-30 9172-31, 9172-32, 9105.41-2 "Type D", 9105.41-3, 9105-41-8 (Powder River H-20 or equal) and 9105.41-4.

5. Campsites

The permit/lease area is located within driving distance of Escalante. However, it is considered that a compsite may be desireable. If needed, the permittee/lessee and BLM will determine the location consistent with environmental relations.

6. Historical or Archeological values - The lesee agrees that any archeological values such as Indian ruins, petroglyphs, pictographs, etc., encountered in its exploration, mining operations and road

construction to promptly notify BLM of such values. The BLM will investigate the findings and determine their significance. If an archeological survey (inventory) is required it will be at lessee's expense.

### 7. Reclamation of Disturbed Areas

Borrow areas and cuts and fills of relocated and new permanent roads will be graded and seeded. All disturbed areas, temporary roads, and campsites will be returned to near normal original ? condition and seeded. It is required that all disturbed areas be seeded in such a manner as to restore an acceptable level of vegetative cover. This may require more than one application of seed and hauling water for seedling establishment. Seedling establishment may extend beyond the termination period of the permit/lease one (1) or more years. Date, rate and type of seed will be determined by BLM dependent upon location of disturbed area such as streambank, sidehill or flat. Seed will be applied with drill on every possible disturbed area. Other disturbed areas will be seeded by hand methods and providing some method of suitable seed coverage.

To prevent or abate environmental contamination, pollutants will be prevented from reaching the air, water or land resources including surface watercourses and groundwater aquifers. No liquids, industrial wastes, or mining residue will be deposited or located so as to be a hazard to stream flow along the major or active waterways.

The lessee will be required to comply with all State and Federal laws and regulations pertaining to the protection of air and water and to the reclamation of surface resources. The location of all industrial

sites within the lease area shall be coordinated with the District Manager as well as rights-of-way for access, power and water uses.

a. To the degree practicable, backfilling, final grading and revegetation shall be completed within one (1) year after the completion or termination of the particular operation.

b. All operations shall be conducted so as to avoid range and forest fires and spontaneous combustion. Open burning of carbonaceous materials shall be subject to state and federal air pollution control measures and in accordance with suitable practices for fire prevention and control. The operator shall take immediate steps to extinguish any fires in piles of coal wastes, slack or in an exposed face of in-place coal. Exposed coal veins or/and flamable deposits shall be covered with soil in order to protect from lightning.

c. All existing improvements including b ut not limited to: gates, cattleguards, roads, trails, pipelines, bridges, public land survey monuments and water development and control structures, shall be replaced, restored or appropriately compensated for as soon as practicable in the event they are damaged or destroyed by company operations.

d. Drill holes or shafts shall be temporarily protected at all times so as to prevent injury to persons, livestock and wildlife; they shall be permanently sealed when the need for the drill hole no longer exists.

e. Surface buildings, supporting facilities and other structures that have served their purpose shall be removed and the area graded and revegetated.

f. Where compatible with operations conducted by the lessee, the lease area shall be available for other public uses including but not limited to livestock grazing, hunting, fishing, camping and hiking.

g. It is further understood by the lessee that as operations progress over a given period of time, special additional use stipulations and reasonable environmental requests may be made by the District Manager depending upon the urgency of unforeseen situations.

8. General Cleanup

The disturbed areas are to be completed as specified in the above specifications. All trees and brush removed during the exploration/mining operations will be piled in an area(s) suitable for burning. Burning of this material will be done in the late fall or early winter season within 5 days following one half inch or more precipitation. All by-products of the exploration/mining operations are to be removed currently from the area or buried.

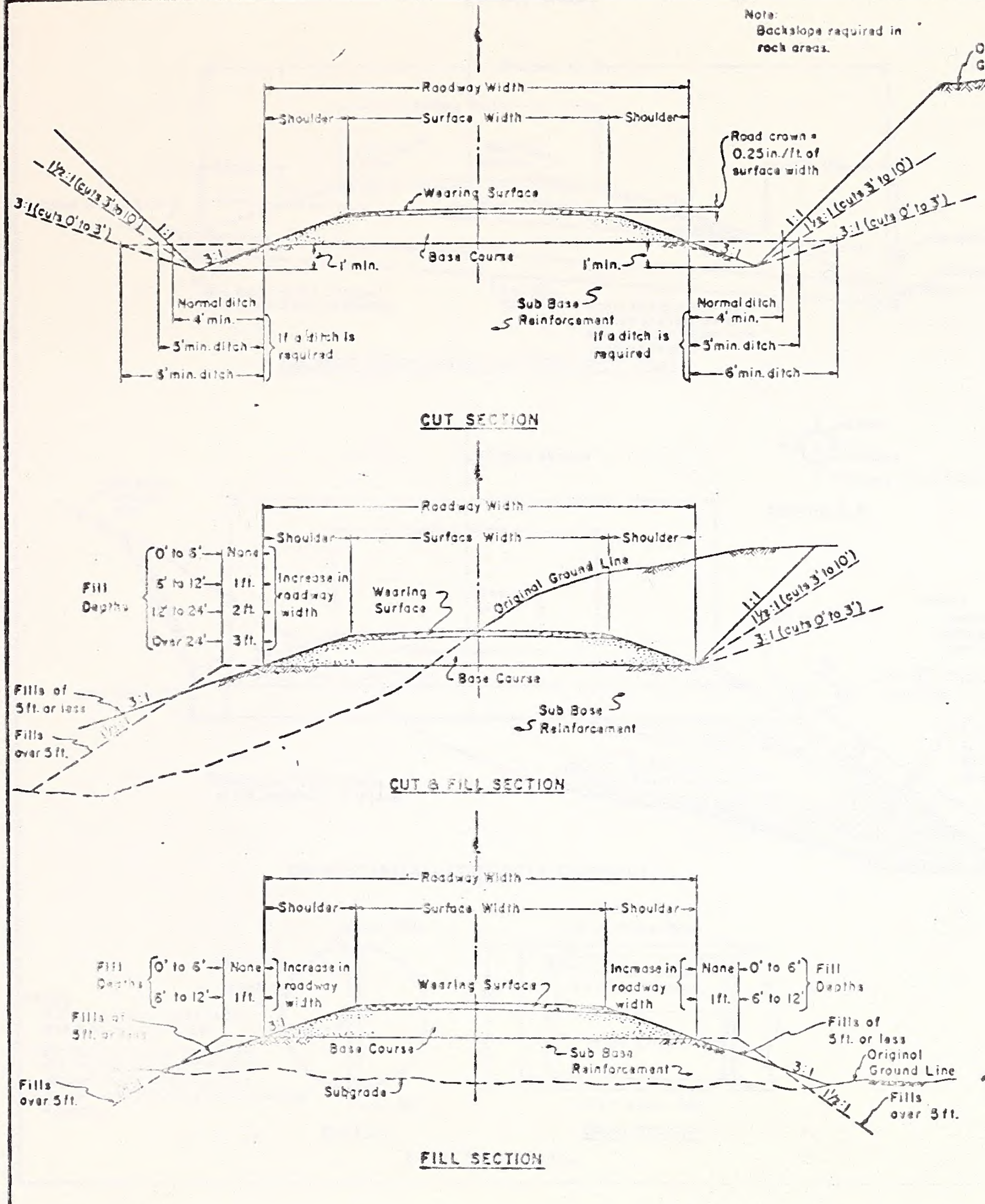
9. Improvements

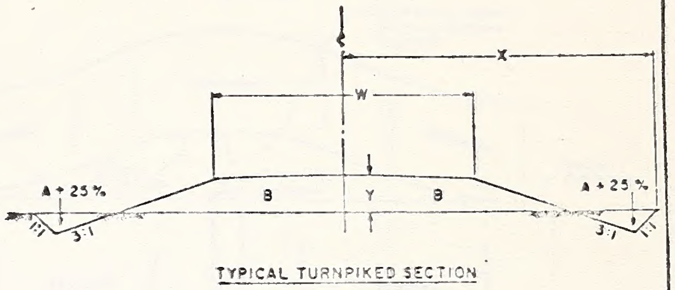
All improvements placed upon the area are to be properly maintained during the term of the permit/lease. At such time certain improvements will either be salvaged by the permittee/lessee or passed into Government ownership as determined by BLM.

10. Bond

A ten thousand dollar $10,000) performance bond shall be required

in order to guarantee site protection, reclamation, removal of all litter, and compliance with all terms of the permit/lease. The bond shall be released by the District Manager following termination and satisfactory compliance with the terms of the permit/lease.

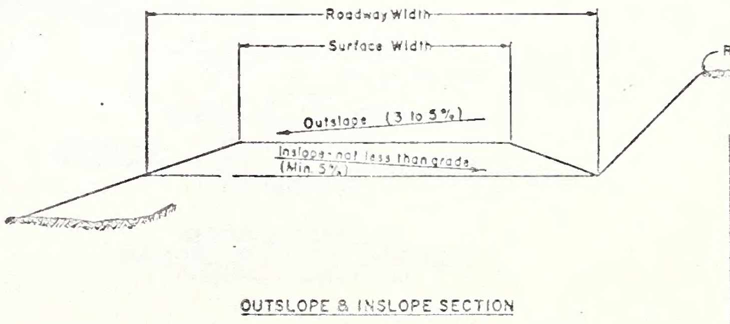




TYPICAL TURNPIKED SECTION

DATA FOR STAKING TURNPIKED SECTIONS
(B + A + 25 % Shrinkage Factor)

| "W" | "X" | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Y=0.25' | Y=0.50' | Y=0.75' | Y=1.00' | Y=1.25' | Y=1.50' | Y=1.75' | Y=2.00' |
| 10'<br>CY/Station | 9.4'<br>12 | 11.9'<br>27 | 14.0'<br>43 | 16.1'<br>60 | 18.0'<br>80 | 19.9'<br>101 | 21.7'<br>124 | 23.6'<br>148 |
| 12'<br>CY/Station | 10.8'<br>13 | 13.3'<br>31 | 15.3'<br>50 | 17.6'<br>70 | 19.7'<br>91 | 21.5'<br>113 | 23.5'<br>140 | 25.4'<br>167 |
| 14'<br>CY/Station | 11.1'<br>17 | 13.7'<br>36 | 17.0'<br>57 | 19.2'<br>79 | 21.3'<br>103 | 23.2'<br>129 | 25.2'<br>156 | 27.1'<br>185 |
| 16'<br>CY/Station | 13.4'<br>19 | 16.1'<br>41 | 18.5'<br>63 | 20.7'<br>88 | 22.8'<br>114 | 24.9'<br>142 | 25.8'<br>172 | 29.8'<br>204 |
| 18'<br>CY/Station | 14.7'<br>22 | 17.5'<br>45 | 19.9'<br>70 | 22.2'<br>97 | 24.4'<br>126 | 26.5'<br>156 | 28.5'<br>188 | 30.5'<br>222 |
| 20'<br>CY/Station | 15.9'<br>24 | 18.8'<br>30 | 21.3'<br>77 | 23.7'<br>107 | 25.9'<br>138 | 28.1'<br>170 | 30.1'<br>205 | 32.1'<br>241 |
| 22'<br>CY/Station | 17.1'<br>26 | 20.1'<br>54 | 22.7'<br>84 | 25.1'<br>116 | 27.3'<br>149 | 29.6'<br>180 | 31.6'<br>221 | 33.7'<br>259 |
| 24'<br>CY/Station | 18.4'<br>29 | 21.5'<br>59 | 24.1'<br>91 | 26.6'<br>125 | 29.0'<br>161 | 31.1'<br>193 | 33.2'<br>237 | 35.3'<br>278 |
| 25'<br>CY/Station | 19.5'<br>31 | 22.8'<br>64 | 25.4'<br>98 | 28.0'<br>134 | 30.4'<br>172 | 32.6'<br>212 | 34.7'<br>253 | 36.9'<br>296 |

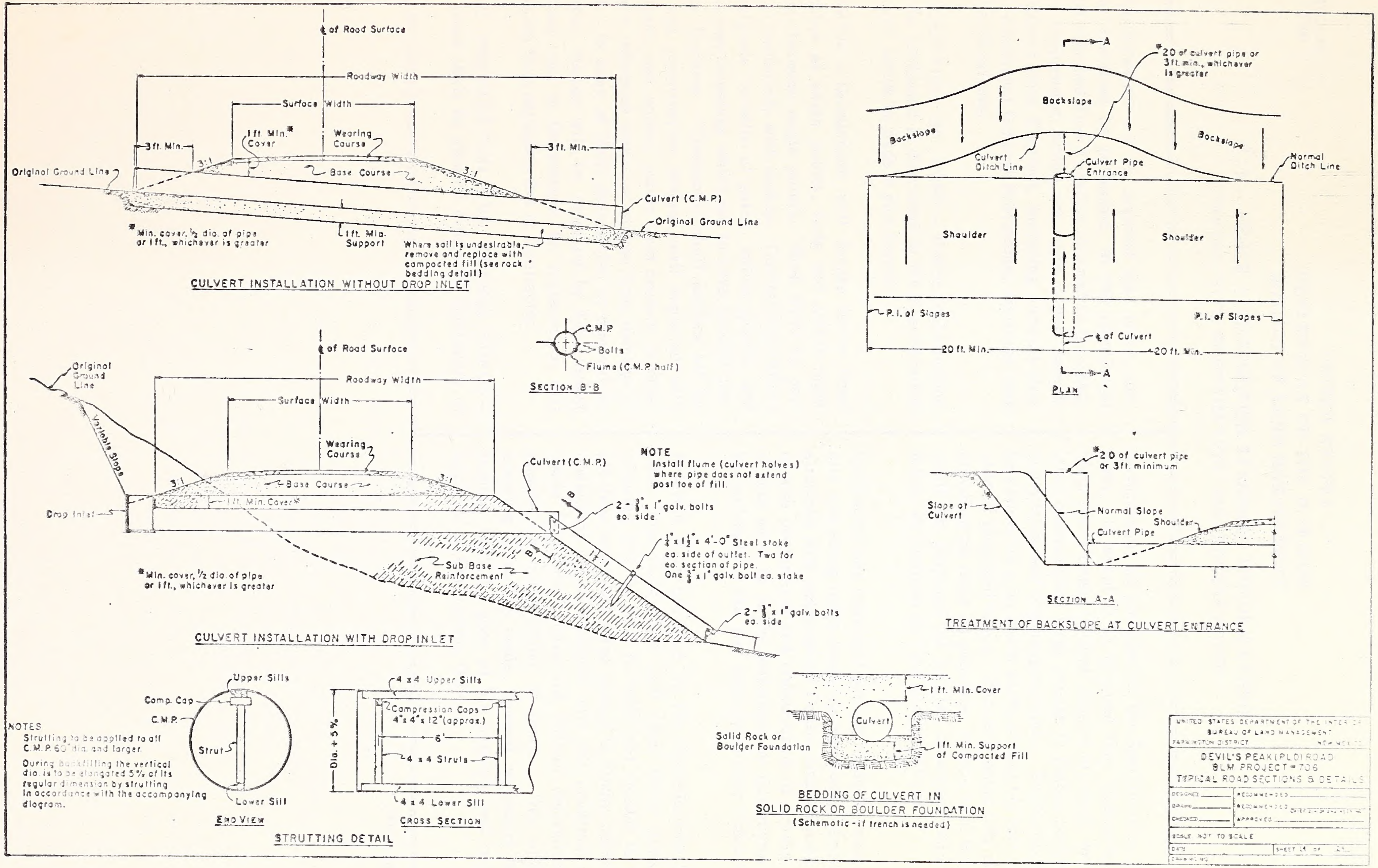

Roadway Width
Surface Width
Rounding as required
Outslope (3 to 5%)
Inslope - not less than grade (Min. 5%)
OUTSLOPE & INSLOPE SECTION

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
FARMINGTON DISTRICT NEW MEXICO

DEVIL'S PEAK (PLD) ROAD
BLM PROJECT # 706
TYPICAL ROAD SECTIONS & DETAILS

DESIGNED ____ RECOMMENDED ____
DRAWN ____ RECOMMENDED ____
CHECKED ____ APPROVED ____
SCALE NOT TO SCALE
DATE ____ SHEET 5 OF 24
DRAWING NO.

# TYPICAL ROAD SECTIONS



CULVERT INSTALLATION WITHOUT DROP INLET

*Min. cover, ½ dia. of pipe or 1 ft., whichever is greater

CULVERT INSTALLATION WITH DROP INLET

*Min. cover, ½ dia. of pipe or 1 ft., whichever is greater

NOTE
Install flume (culvert halves) where pipe does not extend past toe of fill.

SECTION B-B

PLAN

SECTION A-A

TREATMENT OF BACKSLOPE AT CULVERT ENTRANCE

NOTES
Strutting to be applied to all C.M.P. 60" dia. and larger.
During backfilling the vertical dia. is to be elongated 5% of its regular dimension by strutting in accordance with the accompanying diagram.

END VIEW

CROSS SECTION

STRUTTING DETAIL

BEDDING OF CULVERT IN SOLID ROCK OR BOULDER FOUNDATION
(Schematic - if trench is needed)

CULVERT INSTALLATION DETAILS

Form 9172–29
(March 1970)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

# F–1 – FENCE CONSTRUCTION STANDARD SPECIFICATIONS

## STAKING, SITE PREPARATION, AND ACCESS ROADS

A. REQUIREMENT – It is required that fence construction specified be performed, at the location(s) shown on attached *Work Location Map* and in the Specification Supplement, which are made a part hereof, in accordance with Contract, including General Provisions, Additional General Provisions, drawings, and these specifications.

B. DESCRIPTION OF WORK – Fence construction work to be performed is described in the Specification Supplement, which is made a part hereof.

C. STAKING – Government will locate fence lines with stakes at angle points, ends and within sight distances between angle points. Work shall be performed in conformity with stakes. Contracting Officer will designate location of gates, cattle guards, and any drainage crossings which are to have special construction features. Contractor shall protect all location and construction stakes until replaced with fence posts, and protect public land corners or other permanent reference marks or stakes from damage or removal. In case of their destruction or removal by Contractor, stakes will be replaced by Government and actual cost to Government for replacement will be deducted from payments due to Contractor.

D. SITE PREPARATION AND ACCESS ROADS – Fence lines shall be cleared either by Contractor or Government, as provided in the Specification Supplement. In event it is required that Contractor shall clear fence lines, he shall remove all trees, brush and other obstructions large enough to hinder construction operations, and overhanging limbs. Fence lines shall be cleared to a minimum width of four (4) feet on each side of proposed fence. Existing grass sod shall be disturbed as little as possible. Debris from fence line shall be disposed of in the immediate vicinity of fence, as directed by Contracting Officer.

Contractor may construct access roads to construction site and along fence lines, as necessary, during construction with approval of Contracting Officer. Cost of site preparation and construction of access roads, if this work is to be performed by Contractor, shall be included in the pay item for *Fence Construction.*

In event it is provided, in the Specification Supplement, that Government will clear fence lines, such clearing will be done in sufficient amount to remove all trees and brush large enough to hinder construction operations and Government will also construct access roads to extent Contracting Officer determines necessary for construction of fence. Any additional clearing or access roads, deemed necessary by Contractor, shall be done at his expense and only with approval of Contracting Officer.

GPO 856-992

Form 9172-30
(March 1970)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

# F-2 - FENCE MATERIALS

1. GENERAL - All posts, wire, and other materials used in construction of fence; wire gates and any special drainage structures required, may be furnished either by Government or Contractor, as provided in the Specification Supplement.

2. GOVERNMENT-FURNISHED MATERIALS - In event it is provided that Government will furnish fence materials, Contractor shall pick up materials at the Bureau of Land Management warehouse or other location stated in the Specification Supplement. Contractor shall load and transport all materials to worksite and furnish labor and equipment to construct fence as specified. Contractor shall be responsible for all materials in his custody until fence is completed and accepted. All unused materials shall be returned, by Contractor, to location from which they were received or nearer destination if so directed by Contracting Officer. Cost of picking up and transporting materials to and from project site shall be included in unit price per rod bid in the *Fence Construction Schedule.*

3. CONTRACTOR-FURNISHED MATERIALS - In event Contractor is required to furnish fence materials, the following specification subparagraphs (a) through (c) shall apply. Contractor shall furnish new, undamaged materials of the best quality of their respective kinds. Upon request, Contractor shall furnish to Contracting Officer the name of supplier, manufacturer, or producer of all materials.

a. *Fence wire and staples*

(1) Barbed wire shall be two twisted strands of twelve and one-half (12½) gauge galvanized wire with two-point barbs of fourteen (14) gauge wire spaced four (4) inches apart. Wire shall be Type A, zinc coated in accordance with Table 1, Grade 1, of Federal Specification No. RR-F-221b or the latest revision.

(2) Woven-wire fabric will not be a component part of fence unless so stated in *Fence Construction Specification Supplement (F-S).* Woven-wire fabric shall be completely galvanized and of height and design shown on drawings. Wire and design shall be as assigned by the U. S. Department of Commerce Simplified Practice recommendation R9-47 and shall be in accordance with Federal Specification RR-F-221b.

(3) Brace wires shall be of twelve and one-half (12½) gauge barbed wire as specified in 3a(1), above, or nine (9) gauge galvanized wire. Tie wires for wood fence stays shall be smooth, galvanized wire either fourteen (14) or twelve (12) gauge. All other tie wires, including gate post loops, shall be smooth, galvanized, nine (9) gauge wire.

(4) Wire fence stays shall be either conventional twisted wire fence stays manufactured from smooth, galvanized, nine (9) gauge wire or two-piece wire stays manufactured from smooth, galvanized, eight (8) gauge, hard steel wire. Wood fence stays shall be sound straight pieces of any species specified in paragraph 3b(2), below, for fence posts. Treating of wood fence stays will not be required. Stays shall be of uniform length and sufficiently long to extend a minimum of three (3) inches above top fence wire and six (6) inches below bottom wire. Stays shall be not less than two (2) inches nor more than three (3) inches in diameter. Two inch by two inch (2"x2") rough sawn S2S, or S4S pieces will be acceptable.

(5) *Staples* - Staples shall be nine (9) gauge, bright finish, and one and one-half (1½) inches long.

b. *Fence posts*

(1) Steel line posts shall be "T" bar type, channel, or "U" bar type, as Contractor may elect. Each shall have an anchor plate welded or riveted to post and be furnished with not less than five (5) clip type wire fasteners. Steel posts shall be manufactured from wrought, rail, or new billet steel and shall weigh not less than 1.33 pounds per foot exclusive of anchor plate. Anchor plate shall weigh not less than 0.67 pound. Posts with punched tabs for fastening wires are not acceptable. All steel posts shall be painted. Steel posts shall be the length shown on drawings.

(2) All wood posts and wood braces shall be sound and usable single stem posts cut from either green or dead trees. A slight bend in one plane will be acceptable. However, in case of disputes, a line drawn from geometric center of top to geometric center of butt shall not fall outside body of post. Small seasoning checks will be permitted. Twisted, rotted, or otherwise inferior or unsound posts are not acceptable. Following species will be acceptable if treated for full length: ponderosa pine, lodgepole pine, fir, balsam, and tamarack. Split red cedar posts will be acceptable if butt end is treated for a minimum distance of depth setting plus six (6) inches.

The following species will be acceptable without treatment: juniper, red cedar (barked), honey locust, osage orange, and white oak.

Posts and brace rails may be full stem members, sawed members of square cross section, or split members. Full stem members shall have a minimum diameter at small end of three (3) inches for line posts and brace rails, and five (5) inches for all other posts. Sawed members may be rough sawn, S2S, or S4S as Contractor may elect. Sawed members shall have a minimum dimension of four (4) inches by four (4) inches (4"x4") for line posts and brace rails and six (6) inches by six (6) inches (6"x6") for all other posts. Split members shall have a minimum cross sectional area at small end of ten (10) square inches for line posts and brace rails and twenty (20) square inches for all other posts. Slabs and wedge-shaped members will not be acceptable. Lengths of all wood posts shall be as shown on drawings. Fabrication of posts and braces shall be done prior to treatment of wood members. When boring or cutting of a treated member is required at construction site, exposed untreated surface of member shall be thoroughly swabbed with creosote.

Posts to be driven shall be machine-pointed on the end driven into ground.

(3) *Wood treating practices* – Posts and braces to be full length treated shall be full pressure treated with either five (5) percent pentachlorophenol solution or with grade 1 coal tar creosote.

For pentachlorophenol method: five (5) percent pentachlorophenol (per Fed. Spec. TT-W-570) solution in petroleum (conforming to AWPA Standard P9) shall be applied as prescribed in Fed. Spec. TT-W-571g. Minimum net retention of preservative solution shall be six (6) pounds per cubic foot, using empty-cell pressure treating process.

For the creosote method: Grade 1 coal tar creosote meeting AWPA Standard C5-57 shall be applied in accordance with Fed. Spec. TT-W-571g, Table I. Minimum net retention of preservative solution shall be six (6) pounds per cubic foot. Empty-cell pressure treating process shall be used.

If split red cedar posts are to be used with treating only on butt end, this treating may be accomplished by either cold soaking process or hot and cold bath process. Either pentachlorophenol solution or coal tar creosote solution, as prescribed above, may be used. Minimum net retention of preservative solution shall be six (6) pounds per cubic foot of wood treated.

c. *Costs* – Cost of furnishing and delivering all materials to worksite shall be included in the pay item for *Fence Construction.*

Form 9172–31
(March 1970)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

## F–3 – FENCE CONSTRUCTION

1. GENERAL – Using materials specified herein, Contractor shall construct fence in accordance with these specifications and detailed drawings on fence design.

2. INSTALLATION OF POSTS AND BRACES – Depth to which posts shall be placed and spacing of posts and bracings shall be as shown on drawings. Steel posts shall not be used for end panel, corner panel, gate panel, or stress panel posts. All wood posts shall be set in dug holes, except that wood line posts may be driven upon written authorization by the Contracting Officer. Steel posts shall be driven except where rock formations prohibit driving. Posts which are driven shall be free of damage when in place, and any driven post which is split, twisted, or bent, or which has a broomed top shall be removed and shall be replaced with an undamaged post.

When wood posts are to be set in dug holes, holes for posts shall be dug to depth at which posts are to be set and of sufficient diameter to allow setting posts with adequate open space around each post to permit tamping of backfill for full depth of hole. Space around each post shall be filled gradually and uniformly with soil and packed firmly from bottom of hole to ground surface.

Except where rock formations prohibit, steel posts shall be driven into ground to depth shown on drawings or until anchor plate is slightly below ground surface. If rock formations prohibit driving of steel posts, holes of the approximate diameter of steel posts and eighteen (18) inches deep shall be excavated or drilled for placement of posts. Post shall then be placed in hole and grouted, if necessary, to make post solid. All posts shall be set in accurate alignment.

Where rock or other unusual conditions make setting of posts in accordance with above two paragraphs impractical, Contractor may request, in writing, use of figure fours and rock jacks in specific locations. Where such request is granted by Contracting Officer, figure fours shall be used in lieu of steel posts, and rock jacks in lieu of wood posts; except that where a series of figure fours are required, a rock jack shall be substituted for every fifth figure four. Figure fours and rock jacks shall be constructed as shown on drawings.

Corner post assemblies, gate post assemblies, and stress panels shall be constructed to conform with the design on drawings. Stress panels shall be constructed on crests of all hills and at a maximum distance of eighty (80) rods apart where barbed wire only is to be used and forty (40) rods apart where woven wire is to be used. Stress panels are required at all points between which wire is to be stretched.

3. INSTALLATION OF WIRE – Wire shall be tightly and uniformly stretched and snugly stapled to wood posts and attached to steel posts with standard wire clips. In stretching wire, excessive tension shall be avoided. Staples shall be driven into wood until staple comes in contact with wire against post, but not tight enough to crimp wire or prevent free movement of wire between post and staple. Staples shall not be driven parallel to grain of wood. Woven wire shall be attached to posts at top and bottom wires and at a minimum of two intermediate horizontal wires. Fence fabric and barbed wire shall terminate at each end post, gate post, corner post, and stress panel. Each line of barbed wire and each longitudinal wire of fence fabric shall be wrapped around post and spliced to itself with at least four (4) turns.

When wire stays are used, they shall be uniformly spaced between adjacent posts and inserted in successive fence wire strands in such a manner that proper wire spacing will be maintained throughout length of fence. If wood stays are used, they shall be uniformly spaced between adjacent posts and shall be securely fastened to each fence wire by means of smooth wire ties in such a manner that proper wire spacing will be maintained throughout.

Where fence crosses depressions, dips, swales, or other low areas and ground between adjacent posts is more than twenty (20) inches below bottom wire of a barbed wire fence or ten (10) inches below bottom strand of a woven wire fence, an additional strand or strands of barbed wire shall be stretched between successive posts or entire fence shall be weighted down with a rock deadman. Rock deadmen shall weigh a minimum of fifty (50) pounds per fence panel and shall be sufficiently heavy to keep wire from pulling posts from ground. Fence wire strands shall be anchored to deadmen with two or more strands of No. 9 galvanized wire attached to each fence strand to maintain proper spacing.

4. GATES — Wire gates shall be constructed where designated by Contracting Officer. Number of gates required is stated under *Description of Work* in the Specification Supplement. Gates —— and posts and braces on ends of fence on each side of gates —— will be of size and design shown on drawings. Gates shall have same type wire and same wire spacing as rest of fence.

Gates shall be constructed with wood stay ends, with two wood stays equally spaced between. One gate end shall be fastened stationary to end post with three (3) nine (9) gauge wire ties, one near top, one at midpoint, and one near bottom of end stay. Opening end shall be provided with nine (9) gauge smooth wire loops at top and bottom of end stay as is common practice for fastening wire gap gates. Intermediate gate stays shall extend a minimum of three (3) inches above top fence wire and six (6) inches below bottom wire. Both intermediate and end stays shall be approximately three (3) inches in diameter.

5. PAYMENT — Measurement for payment will be actual length along ground surface under completed fence including all gate and cattle guard openings, but not including special drainage crossings for which separate payment is provided in the Bid Schedule. Payment for fence construction, completed in conformance with these specifications, will be made at unit price per rod bid in the Schedule. Such payment will be full compensation for all materials, if any, which are required to be furnished by Contractor, transporting of materials, all work necessary to construct fence described in this paragraph, and any other work required to be included in the pay item for *Fence Construction*.

Form 9172–32
(March 1970)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

# F–4 – CONSTRUCTION OF DRAINAGE CROSSINGS

1. GENERAL – Major drainage crossings which cannot be closed by weighting or adding strands of wire as described in *Fence Construction (F-3)* shall be designated by Contracting Officer and shall be closed off by one of four methods detailed on drawings and further described as follows:

a. *Type I drainage crossing* – Main fence shall be carried directly across gully without following slopes of steep banks and bottom of gully, and an auxiliary fence of wire, rock weights, and posts shall be constructed under main fence. Such auxiliary fence shall be independent of main fence so that if it is washed out, main fence will not be damaged. This type crossing shall not be used where the distance across the gully (bank-to-bank) exceeds one hundred (100) feet.

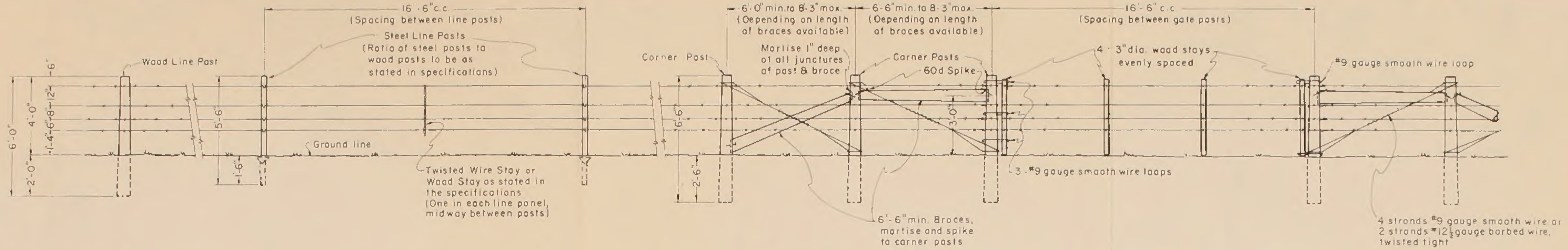
b. *Type II drainage crossing* – Main fence shall be dead ended at either side of gully and at least one (1) rod back from top of channel bank. An additional panel which may be damaged by bank erosion without dead ends being endangered shall be constructed to edge of bank to close off livestock. An auxiliary fence of wire, rock weights, and posts shall be constructed across channel bottom.

c. *Type III drainage crossing* – Main fence shall be dead ended at each side of gully and at least one (1) rod back from top of channel bank. An additional panel which may be damaged by bank erosion without dead ends being endangered shall be constructed to edge of bank to close off livestock. A swing panel shall be constructed of standard fence wire materials with log floats as weights on bottom. Panel shall be suspended by one-half (½) inch or larger, diameter wire rope anchored to deadmen on each side of channel.

d. *Type IV drainage crossing* – Main fence shall be dead ended at each side of gully and at least one (1) rod back from top of channel bank. An additional panel which may be damaged by bank erosion without dead ends being endangered shall be constructed to edge of bank to close off livestock. A swing panel shall be constructed of 2"x4" lumber and/or three (3) inch diameter poles. Panel shall be suspended by one-half (½) inch or larger, diameter wire rope anchored to deadmen on each side of channel.

2. PAYMENT – Payment will be made at unit price per drainage crossing bid in the Schedule. Such payment will be full compensation for all work necessary to construct drainage crossing as described in this paragraph and any other work, cost of which is required to be included in this unit price. Compensation for all materials, if any, which are to be furnished by Contractor and for transporting materials will also be included in the pay item for *Construction of Drainage Crossings.*

GPO 857-002

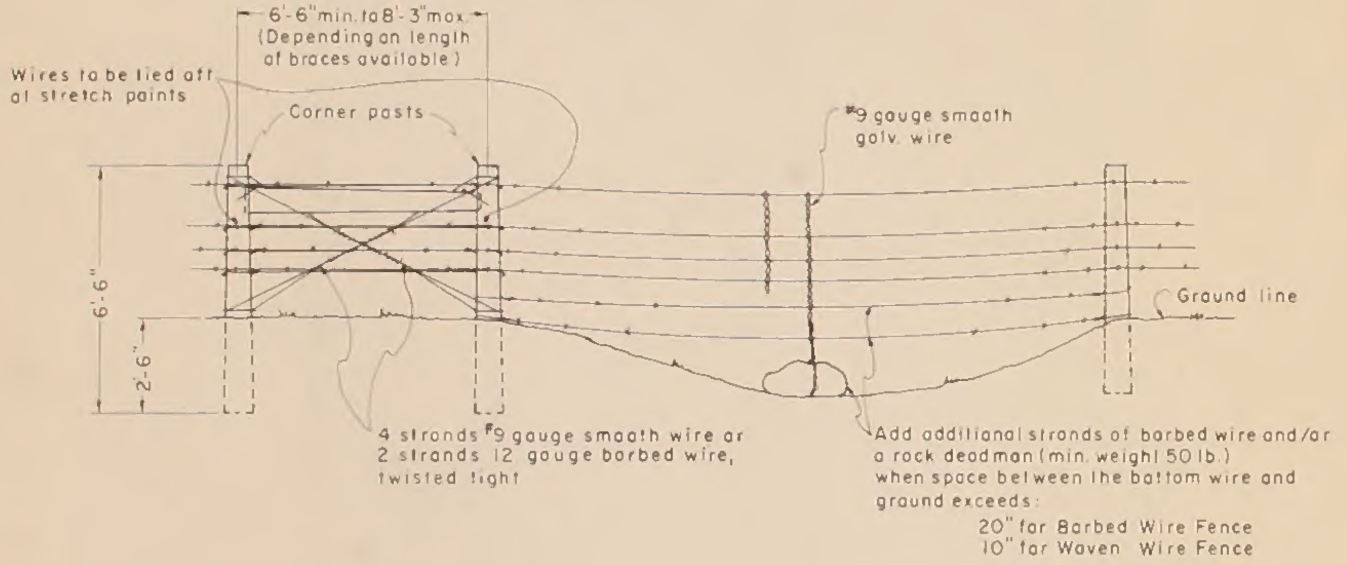

16'-6" c.c.
(Spacing between line posts)
Steel Line Posts
(Ratio of steel posts to wood posts to be as stated in specifications)
Wood Line Post
6"
12"
8"
6"
1'-4"
4'-0"
6'-0"
2'-0"
5'-6"
1'-6"
Ground line
Twisted Wire Stay or Wood Stay as stated in the specifications
(One in each line panel, midway between posts)
6'-6"
2'-6"
Corner Post
6'-0" min. to 8'-3" max.
(Depending on length of braces available)
6'-6" min. to 8'-3" max.
(Depending on length of braces available)
Mortise 1" deep at all junctures of post & brace
Corner Posts
60d Spike
3'-0"
3-#9 gauge smooth wire loops
6'-6" min. Braces, mortise and spike to corner posts
16'-6" c.c.
(Spacing between gate posts)
4 - 3" dia. wood stays evenly spaced
#9 gauge smooth wire loop
4 strands #9 gauge smooth wire or 2 strands #12½ gauge barbed wire, twisted tight

4 STRAND BARBED WIRE FENCE
TYPE "D"

LINE PANEL

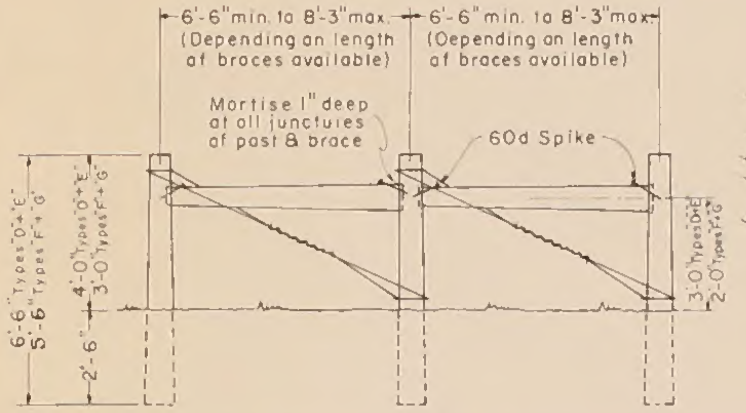
PANEL AT GATES & CATTLEGUARDS

GATE PANEL

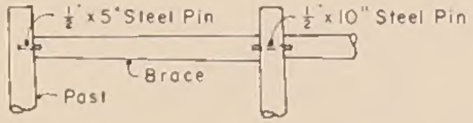

6'-6" min. to 8'-3" max.
(Depending on length of braces available)
Wires to be tied off at stretch points
Corner posts
6'-6"
2'-6"
#9 gauge smooth galv. wire
Ground line
4 strands #9 gauge smooth wire or 2 strands 12 gauge barbed wire, twisted tight
Add additional strands of barbed wire and/or a rock deadman (min. weight 50 lb.) when space between the bottom wire and ground exceeds:
20" for Barbed Wire Fence
10" for Woven Wire Fence

STRESS PANEL

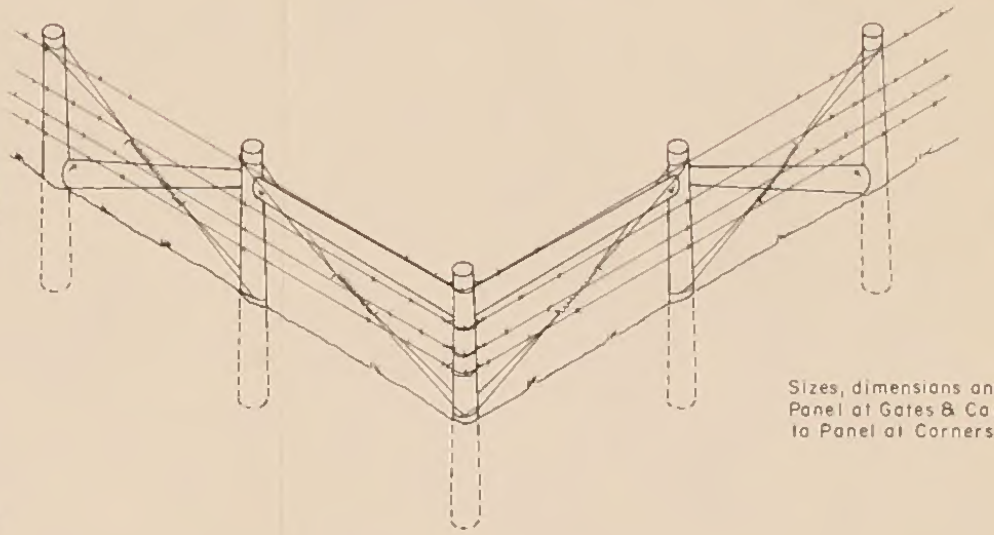
PANEL AT MINOR DEPRESSIONS



ALTERNATE STYLE PANEL AT
GATES, CATTLEGUARDS & CORNERS

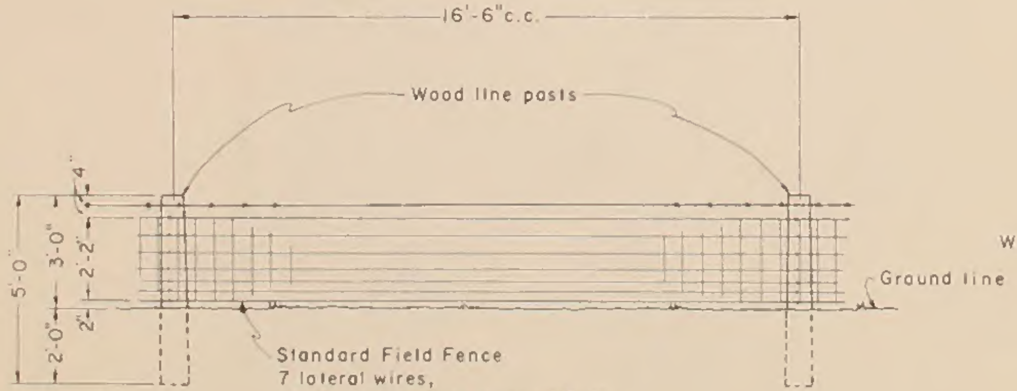


DOWELED CONNECTIONS
(Alternate for mortise-spike connections)



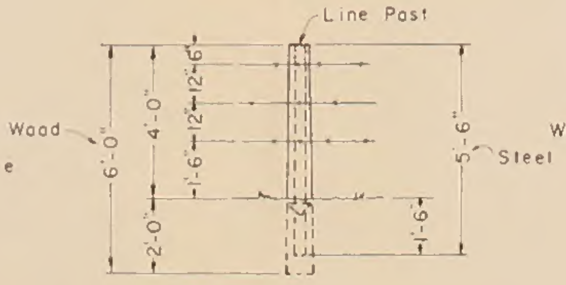
PANEL AT CORNERS

Sizes, dimensions and notes applicable to Panel at Gates & Cattleguards also apply to Panel at Corners.

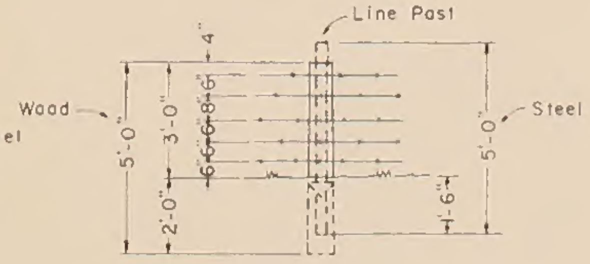

16'-6" c.c.
Wood line posts
4"
2'-2"
3'-0"
5'-0"
2"
2'-0"
Ground line
Standard Field Fence
7 lateral wires,
vertical stay wires spaced @ 6",
top & bottom wires #10 gauge,
intermediate & stay wires #12½ gauge

LINE PANEL
WOVEN WIRE FENCE - TYPE "G"

Note: 32" ht. woven wire (8 lateral wires) with no barbed wire may be used when specified by the Contracting Officer.



3 STRAND BARBED WIRE FENCE
TYPE "E"



5 STRAND BARBED WIRE FENCE
TYPE "F"

NOTE

All panel assemblies to be constructed identical to those for Type D fence except that the posts for Types F and G are 12 inches shorter.

| REV. NO. | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|
| 2 | CHANGED WIRE SPACING TYPE "F" | 12/14/66 | |
| 1 | CHANGED WIRE SPACING FOR FENCE TYPES "F" & "G" | 4/21/66 | |

REVISIONS

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
DIV. ENGINEERING WASHINGTON OFFICE

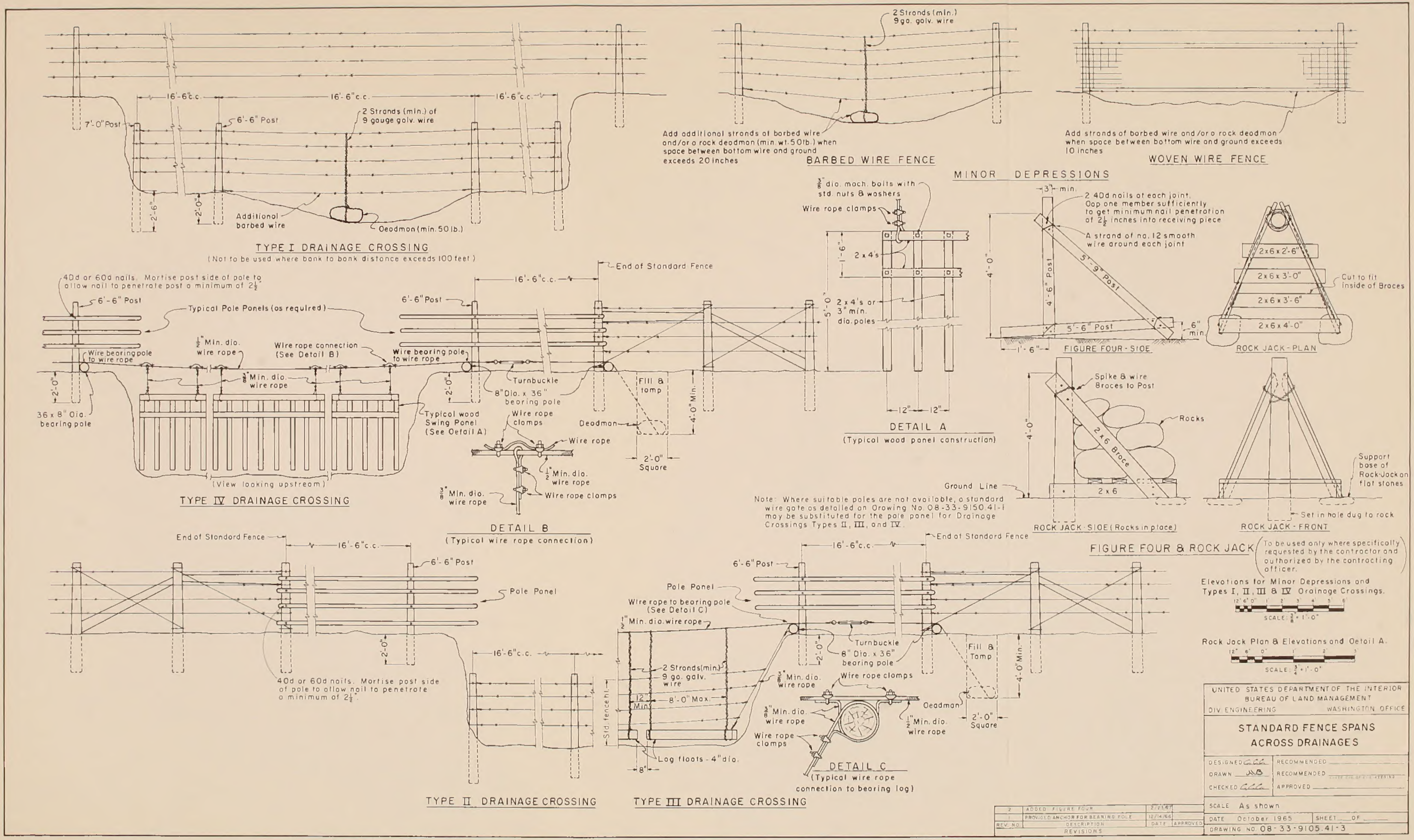
# WIRE LIVESTOCK FENCES FOR USE ON ANTELOPE RANGES

DESIGNED C.C.C.
DRAWN
CHECKED C.C.C.
RECOMMENDED
RECOMMENDED
CHIEF, DIV. OF ENGINEERING
APPROVED

SCALE 12" 6" 0 1' 2' 3' 4' 5' 6'

DATE October 1965
SHEET OF

DRAWING NO. 08-33-9105.41-2



TYPE I DRAINAGE CROSSING

(Not to be used where bank to bank distance exceeds 100 feet)

Add additional strands of barbed wire and/or a rock deadman (min. wt. 50 lb.) when space between bottom wire and ground exceeds 20 inches

BARBED WIRE FENCE

Add strands of barbed wire and/or a rock deadman when space between bottom wire and ground exceeds 10 inches

WOVEN WIRE FENCE

MINOR DEPRESSIONS

TYPE IV DRAINAGE CROSSING

DETAIL B

(Typical wire rope connection)

DETAIL A

(Typical wood panel construction)

Note: Where suitable poles are not available, a standard wire gate as detailed on Drawing No. 08-33-9150.41-1 may be substituted for the pole panel for Drainage Crossings Types II, III, and IV.

FIGURE FOUR - SIDE

ROCK JACK - PLAN

ROCK JACK - SIDE (Rocks in place)

ROCK JACK - FRONT

FIGURE FOUR & ROCK JACK (To be used only where specifically requested by the contractor and authorized by the contracting officer.)

Elevations for Minor Depressions and Types I, II, III & IV Drainage Crossings.

Rock Jack Plan & Elevations and Detail A.

TYPE II DRAINAGE CROSSING

TYPE III DRAINAGE CROSSING

DETAIL C

(Typical wire rope connection to bearing log)

| REV. NO. | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|
| 2 | ADDED FIGURE FOUR | 2/1/67 | |
| 1 | PROVIDED ANCHOR FOR BEARING POLE | 12/14/66 | |

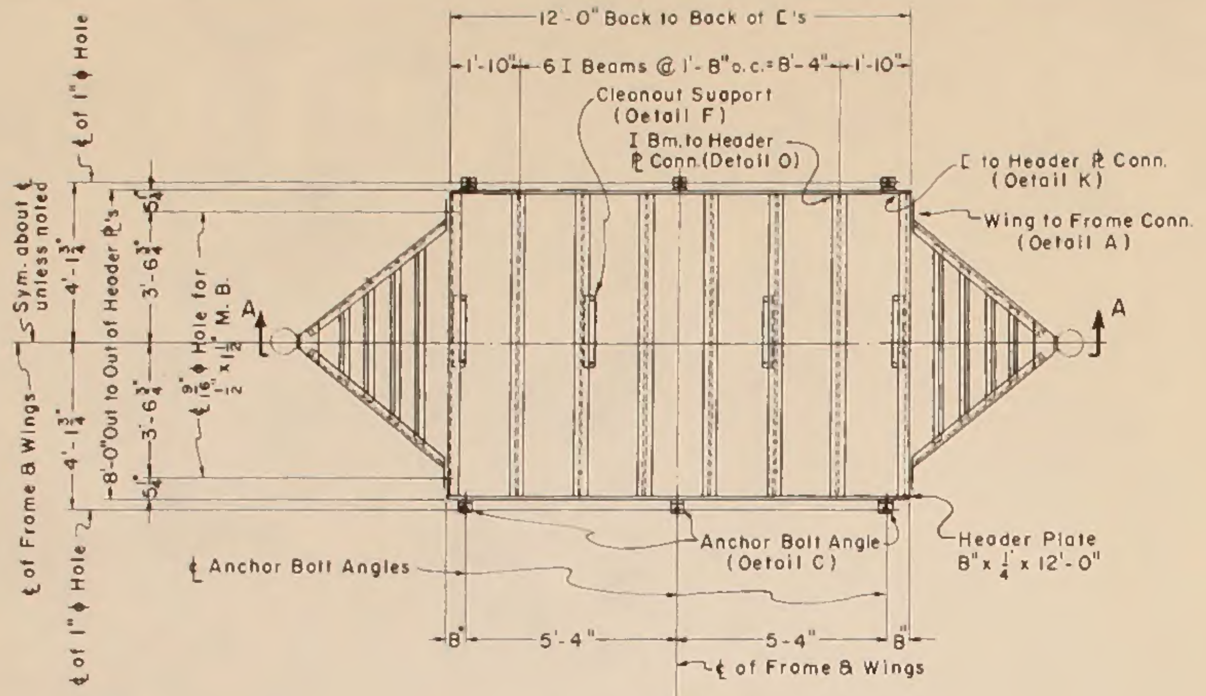
REVISIONS

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
DIV ENGINEERING WASHINGTON OFFICE

STANDARD FENCE SPANS
ACROSS DRAINAGES

DESIGNED C.C.C.
DRAWN JJB
CHECKED C.C.C.
RECOMMENDED ____
RECOMMENDED ____
APPROVED ____

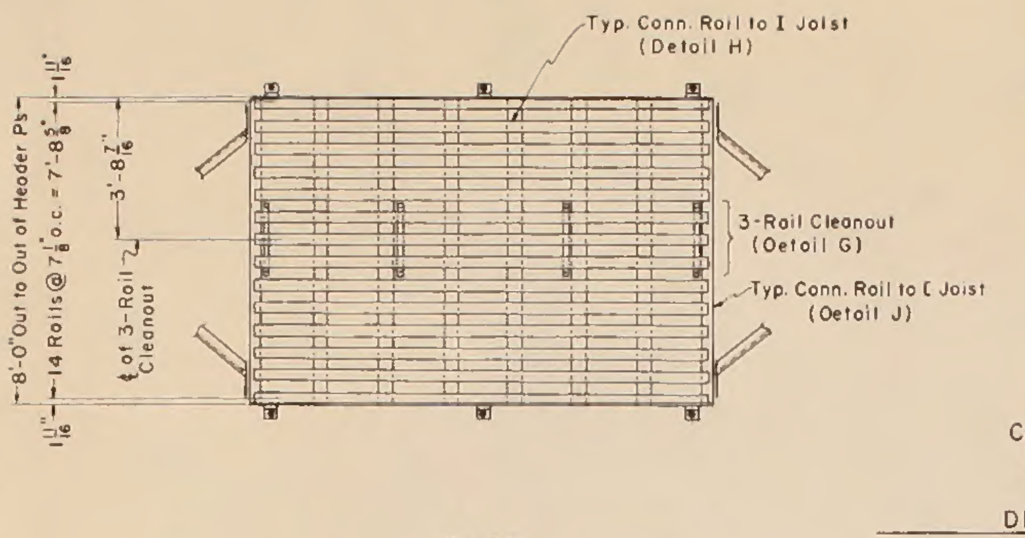
SCALE As shown
DATE October 1965 SHEET ___ OF ___
DRAWING NO. 08-33-9105.41-3


12'-0" Back to Back of C's
1'-10" – 6 I Beams @ 1'-8" o.c. = 8'-4" – 1'-10"
Cleanout Support (Detail F)
I Bm. to Header ℞ Conn. (Detail D)
C to Header ℞ Conn. (Detail K)
Wing to Frame Conn. (Detail A)
℄ of 1" ϕ Hole
Sym. about ℄ unless noted
4'-1 3/4"
3'-6 3/4"
5 1/4"
8'-0" Out to Out of Header ℞'s
℄ 9/16" ϕ Hole for 1/2" x 1 1/2" M. B.
℄ of Frame & Wings
A
A
℄ Anchor Bolt Angles
Anchor Bolt Angle (Detail C)
Header Plate 8" x 1/4" x 12'-0"
8"
5'-4"
5'-4"
8"
℄ of Frame & Wings

PLAN

(Cattleguard Frame with Rolls Removed)

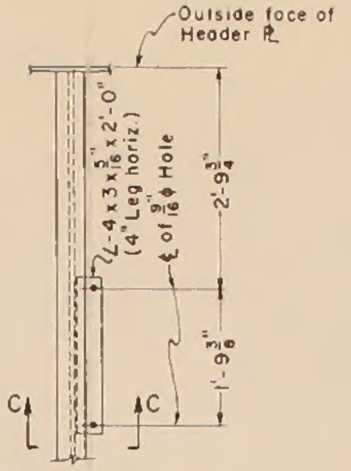
SCALE: 3/8" = 1'-0"


8'-0" Out to Out of Header ℞'s
14 Rolls @ 7 1/8" o.c. = 7'-8 3/8"
1 11/16"
3'-8 7/16"
℄ of 3-Roll Cleanout
Typ. Conn. Roll to I Joist (Detail H)
3-Roll Cleanout (Detail G)
Typ. Conn. Roll to C Joist (Detail J)

PLAN

(Roll Locations)

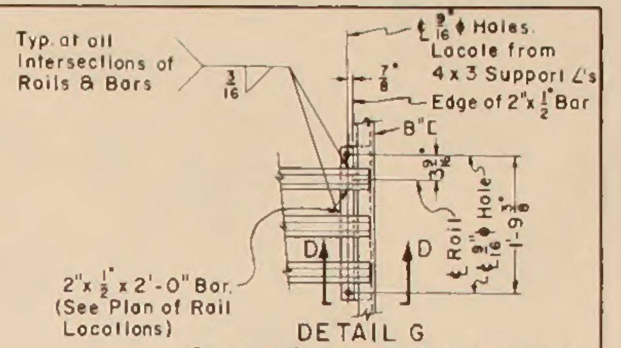
SCALE: 3/8" = 1'-0"



DETAIL F

(Support for 3-Roll Cleanout)
I Joist with Support ∠ (1 R.H. & 1 L.H.)
C Joist with Support ∠ (1 R.H. & 1 L.H.)

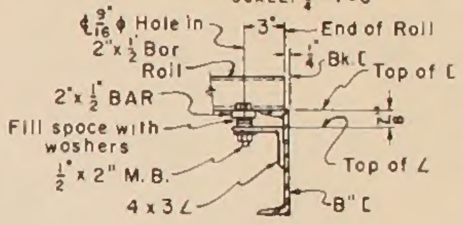
SCALE: 3/4" = 1'-0"


Typ. at all Intersections of Rolls & Bars
3/16
℄ 9/16" ϕ Holes. Locate from 4 x 3 Support ∠'s
7/8"
Edge of 2" x 1/2" Bar
8" C
2" x 1/2" x 2'-0" Bar. (See Plan of Roll Locations)
D
D
℄ Roll
℄ 9/16" ϕ Hole
1'-9 3/8"

DETAIL G

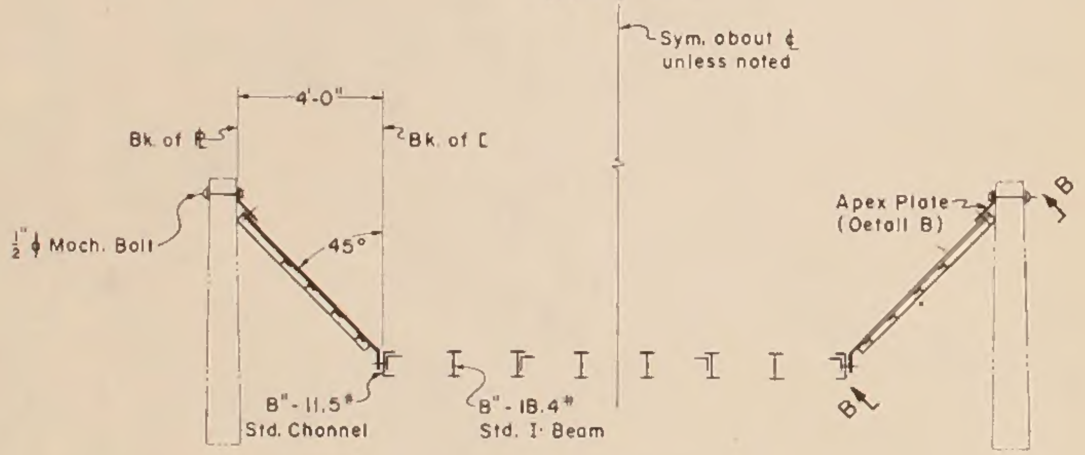
Bar to Roll Conn. for 3-Roll Cleanout

SCALE: 3/4" = 1'-0"



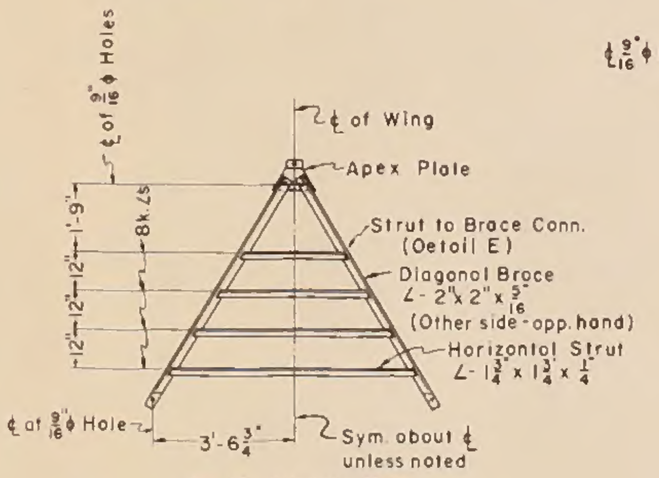
SECTION D-D

SCALE: 1 1/2" = 1'-0"



SECTION A-A

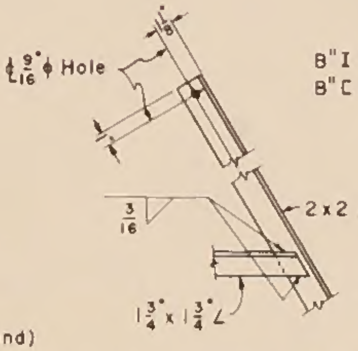
SCALE: 3/8" = 1'-0"


℄ of 9/16" ϕ Holes
℄ of Wing
Apex Plate
Strut to Brace Conn. (Detail E)
Diagonal Brace ∠- 2" x 2" x 5/16" (Other side - opp. hand)
Horizontal Strut ∠- 1 3/4" x 1 3/4" x 1/4"
4'-8 3/4"
1'-9"
1'-2"
1'-2"
1'-2"
℄ of 9/16" ϕ Hole
3'-6 3/4"
Sym. about ℄ unless noted

ELEVATION B-B

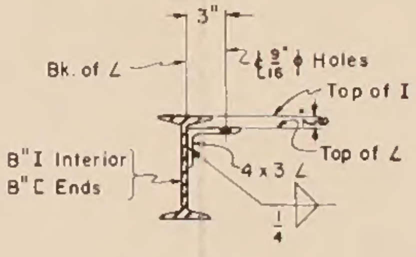
(Cattleguard Wing)

SCALE: 3/8" = 1'-0"



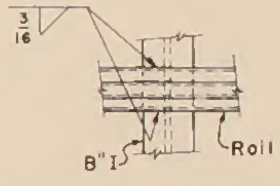
DETAIL E

SCALE: 1 1/2" = 1'-0"



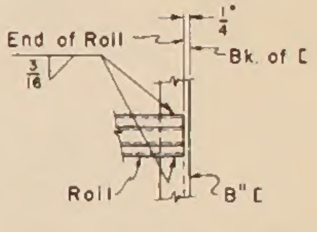
SECTION C-C

SCALE: 1 1/2" = 1'-0"



DETAIL H

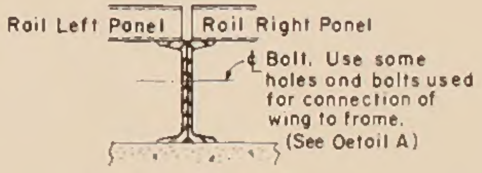
(Typ. Conn. Roll to I Joist)



DETAIL J

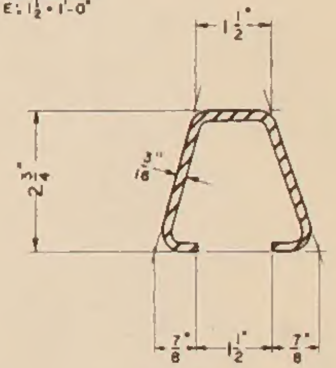
(Typ. Conn. Roll to C Joist)

SCALE: 1 1/2" = 1'-0"


Roll Left Panel
Roll Right Panel
℄ Bolt. Use same holes and bolts used for connection of wing to frame. (See Detail A)

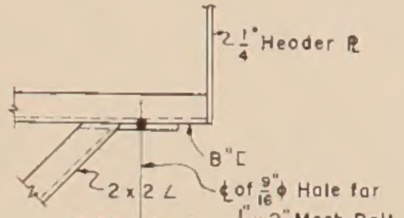
CONNECTION FOR MULTIPLE INSTALLATION

SCALE: 1 1/2" = 1'-0"



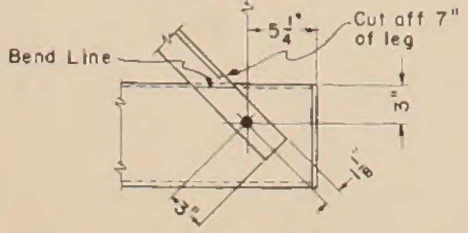
RAIL DETAIL

SCALE: 6" = 1'-0"



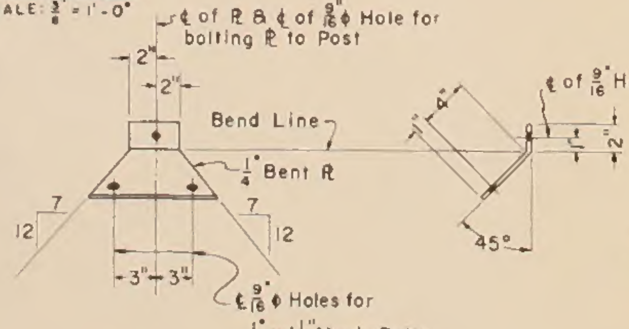
DETAIL A

(Conn. of Wing to Frame)
(Rolls Removed)



ELEVATION

SCALE: 1 1/2" = 1'-0"

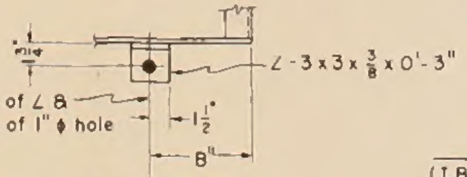

℄ of ℞ & ℄ of 9/16" ϕ Hole for bolting ℞ to Post
2"
2"
Bend Line
1/4" Bent ℞
7
12
7
12
3" 3"
℄ 9/16" ϕ Holes for 1/2" x 1 1/2" Mach. Bolts
℄ of 9/16" Hole
4"
1"
2"
45°

DETAIL B

(Apex Plate)

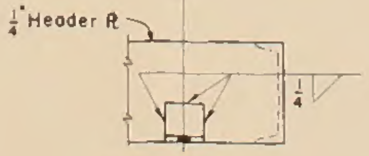
ELEVATION

SCALE: 1 1/2" = 1'-0"



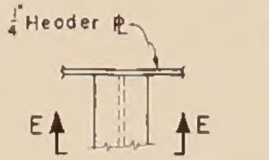
DETAIL C

(Anchor Bolt Angle)



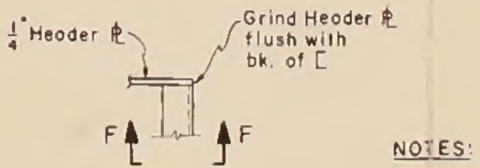
ELEVATION

SCALE: 1 1/2" = 1'-0"



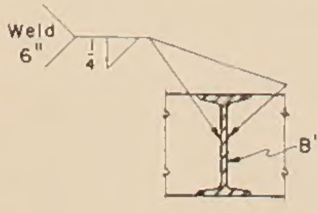
DETAIL D

(I Bm. Joist to Header ℞ Conn.)

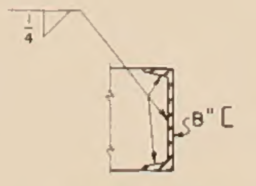


DETAIL K

(C Joist to Header ℞ Conn.)



SECTION E-E



SECTION F-F

SCALE: 1 1/2" = 1'-0"

NOTES:

Use single panel (12') for single lane roads.

Connect two panels together (24') for double lane roads.

Designed for H-20 loading.

Approximate weight single 12'-0" panel section: 2280#.

Approximate weight wings per pair: 480#.

All bolts to be supplied with std. nut and std. washer.

Rolls to be cold formed of 3/16" steel plate.

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
DIV. ENGINEERING WASHINGTON OFFICE

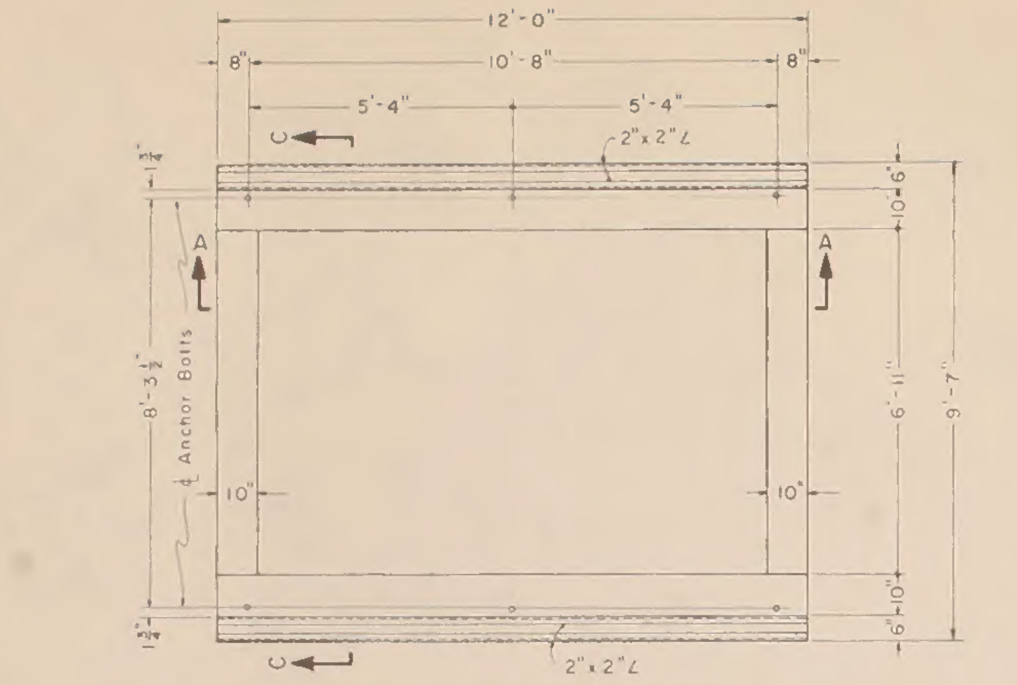
STANDARD STEEL CATTLEGUARD

| | |
|---|---|
| DESIGNED CCC | RECOMMENDED |
| DRAWN | RECOMMENDED |
| CHECKED CCC | APPROVED |

SCALE As shown

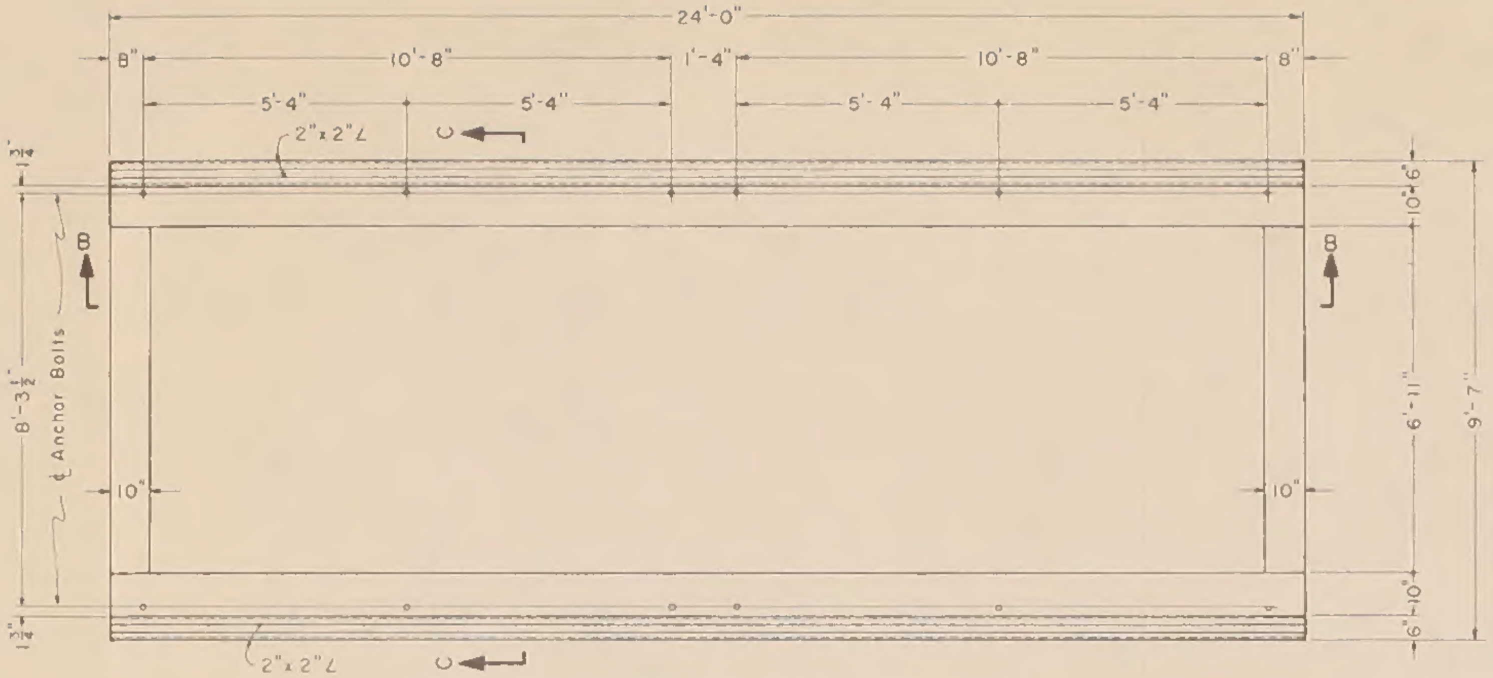
DATE October 1965 SHEET __ OF __

DRAWING NO. 08-33-9105.41-4



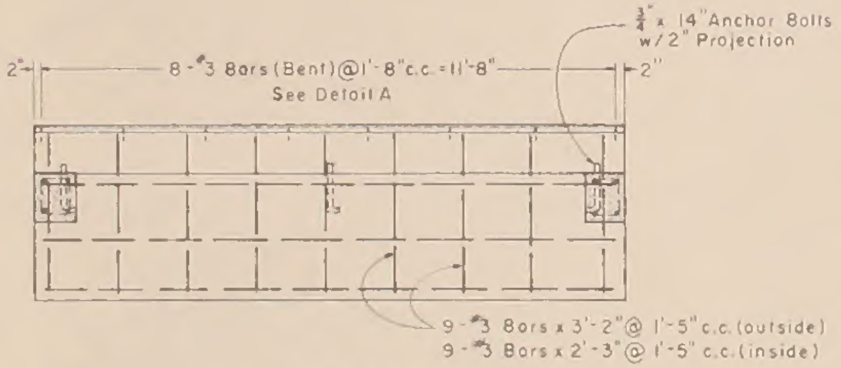
PLAN (Foundation for 12ft. Cattleguard)

SCALE: ½"=1'-0"



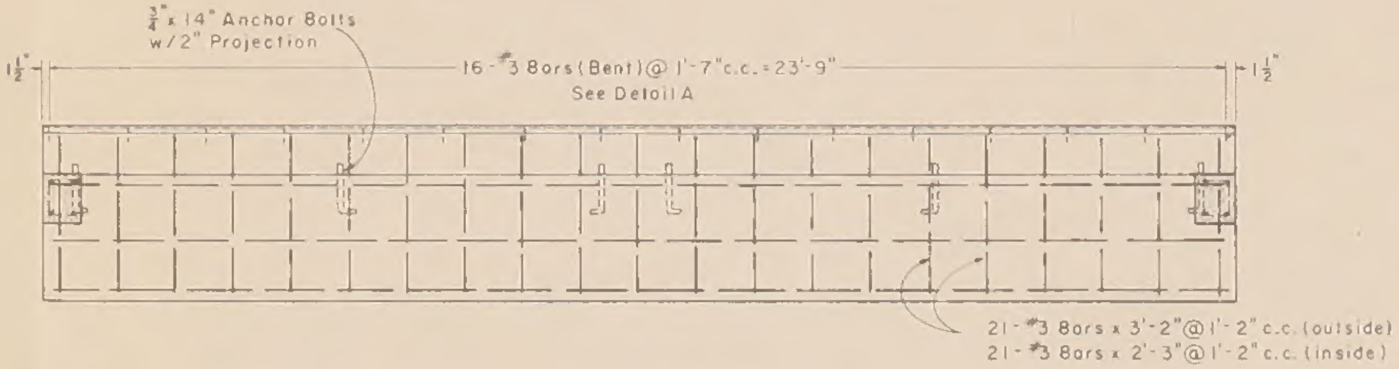
PLAN (Foundation for 24ft. 2-Panel Cattleguard)

SCALE: ½"=1'-0"


¾" x 14" Anchor Bolts
w/2" Projection
2"
8-#3 Bars (Bent) @ 1'-8" c.c. = 11'-8"
See Detail A
2"
9-#3 Bars x 3'-2" @ 1'-5" c.c. (outside)
9-#3 Bars x 2'-3" @ 1'-5" c.c. (inside)

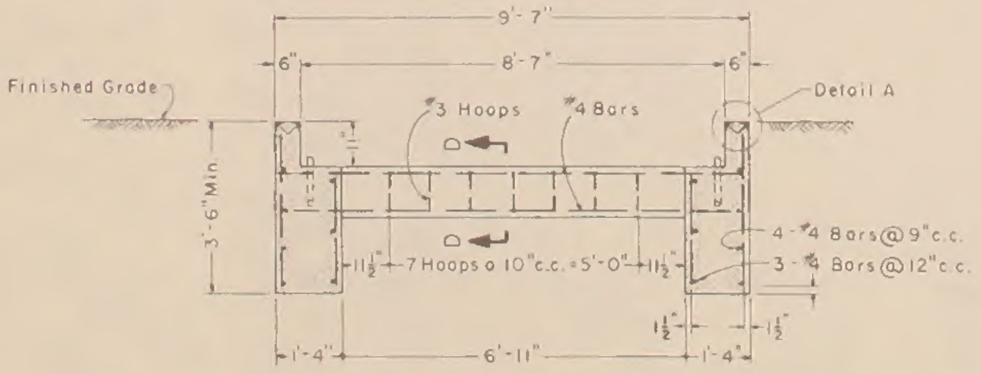
SECTION A-A

SCALE: ½"=1'-0"


¾" x 14" Anchor Bolts
w/2" Projection
1½"
16-#3 Bars (Bent) @ 1'-7" c.c. = 23'-9"
See Detail A
1½"
21-#3 Bars x 3'-2" @ 1'-2" c.c. (outside)
21-#3 Bars x 2'-3" @ 1'-2" c.c. (inside)

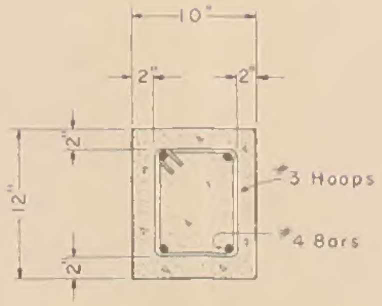
SECTION B-B

SCALE: ½"=1'-0"



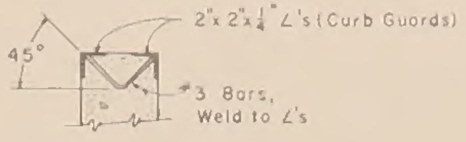
SECTION C-C

SCALE: ½"=1'-0"



SECTION D-D

SCALE: 1½"=1'-0"



DETAIL A

SCALE: 1½"=1'-0"

NOTES:

3.9 cu. yd. reinforced concrete required for 12 ft. Foundation.

7.5 cu. yd. reinforced concrete required for 24 ft. Foundation.

Standard nuts and washers to be furnished with each foundation unit.

Where necessary, the location and spacings of the anchor bolts shall be adjusted to fit the particular cattleguards furnished.

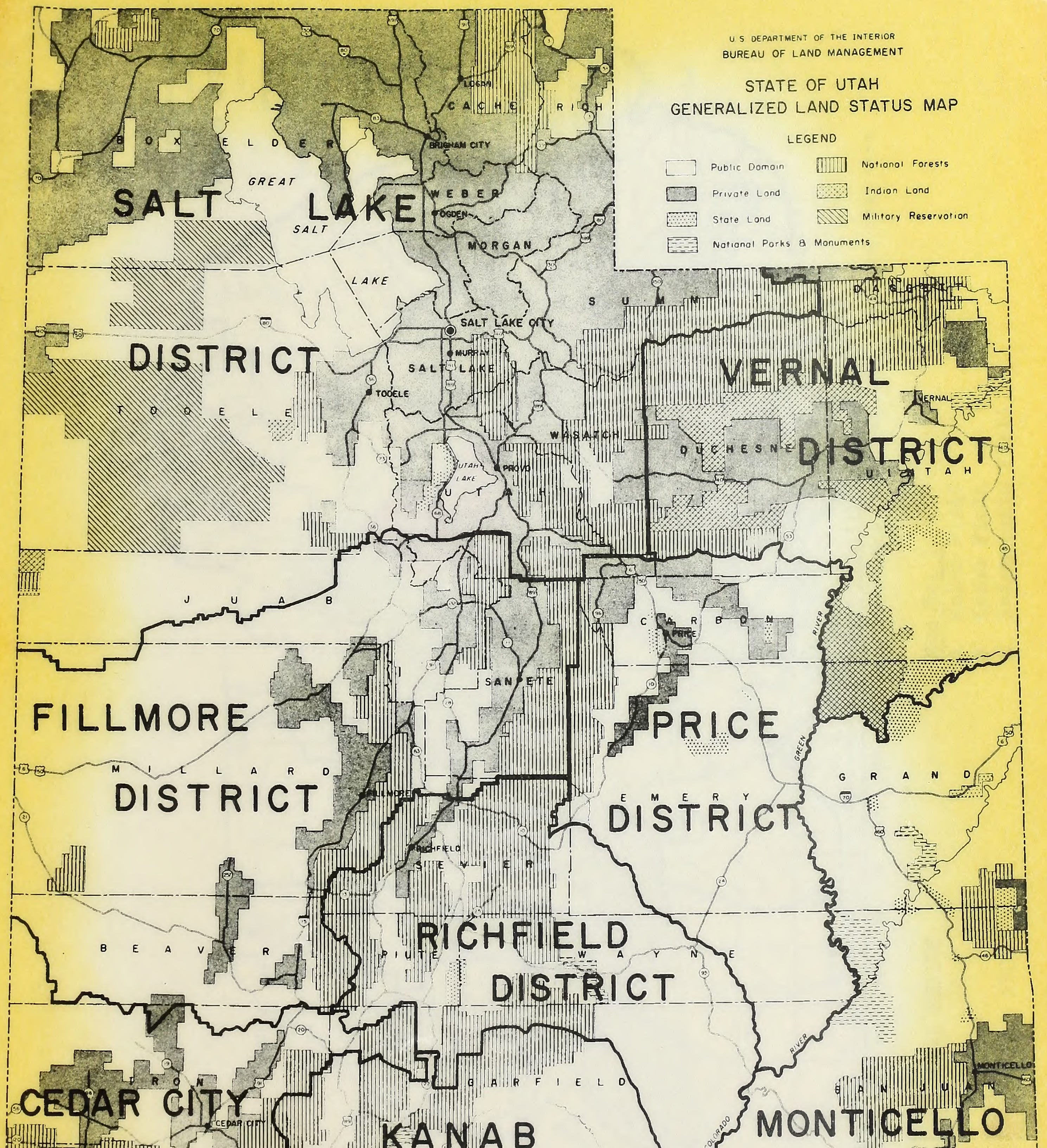
UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

CONCRETE FOUNDATIONS (TYPE II)
FOR
STANDARD STEEL CATTLEGUARD

DESIGNED ERB
DRAWN JWB
CHECKED CCC
RECOMMENDED
RECOMMENDED
CHIEF, DIV. OF ENGINEERING
APPROVED
SCALE
DATE December 1966
SHEET ___ OF ___
DRAWING NO. 08-33-9105-41-8

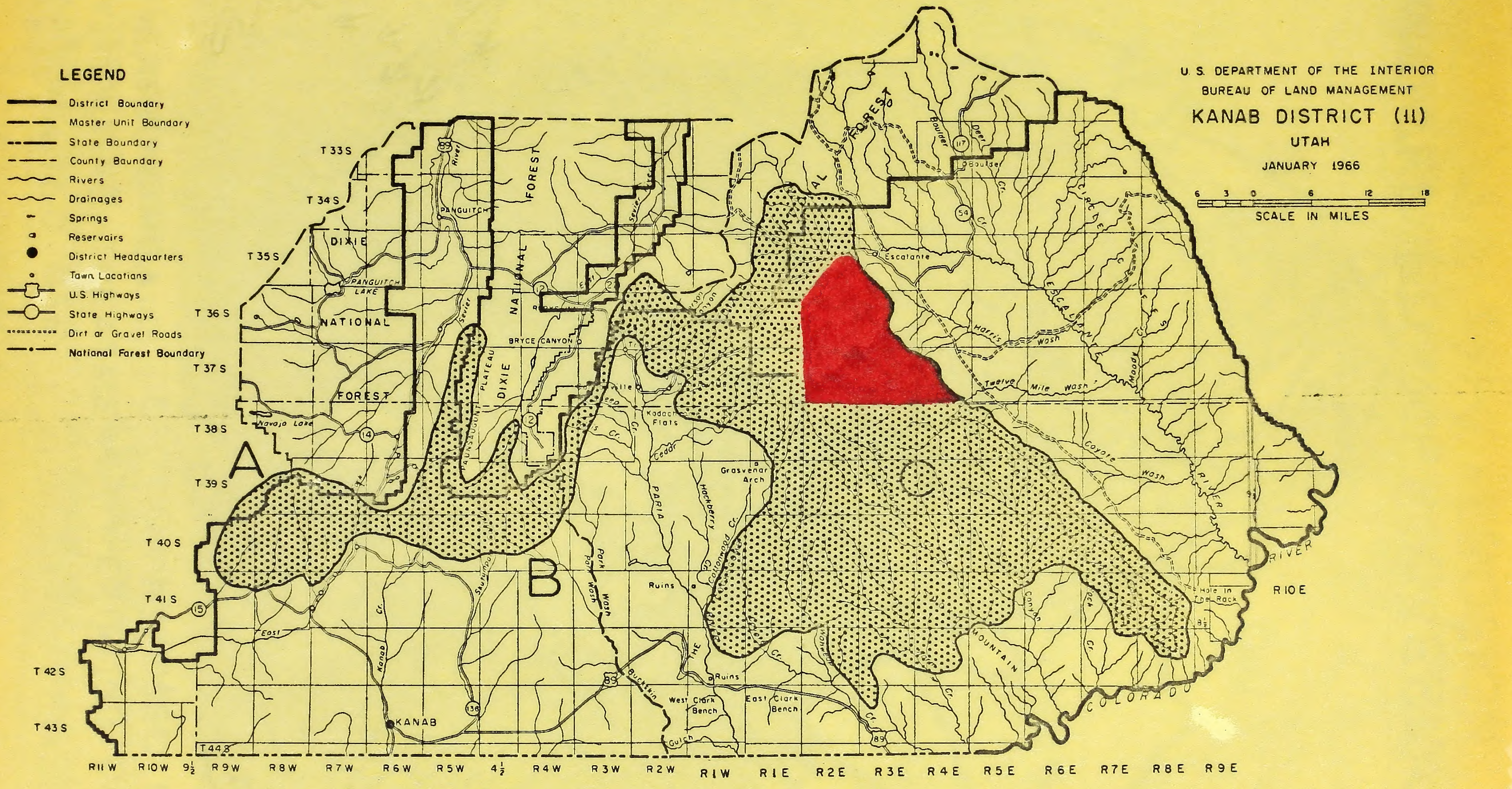
GPO 837-491

VII. Maps & Photos



U S DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

STATE OF UTAH
GENERALIZED LAND STATUS MAP

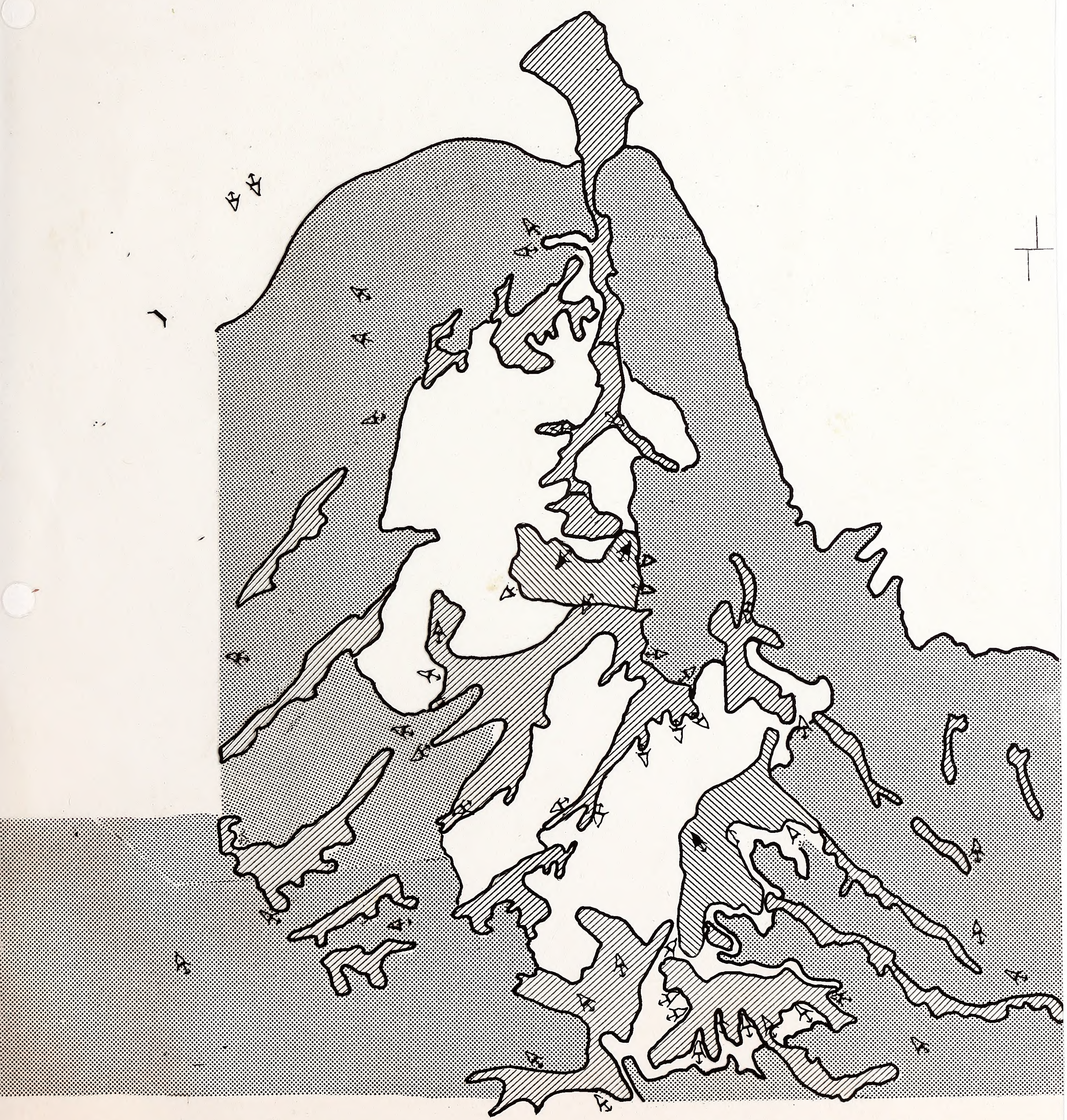


▨ COAL FIELDS

🟥 STUDY AREA

Map No. 1
A Kolob Field
B Kanab Field
C Kaiparowits Field

# WATERSHED M.F.P. OVERLAY



▨ TREATED AREA

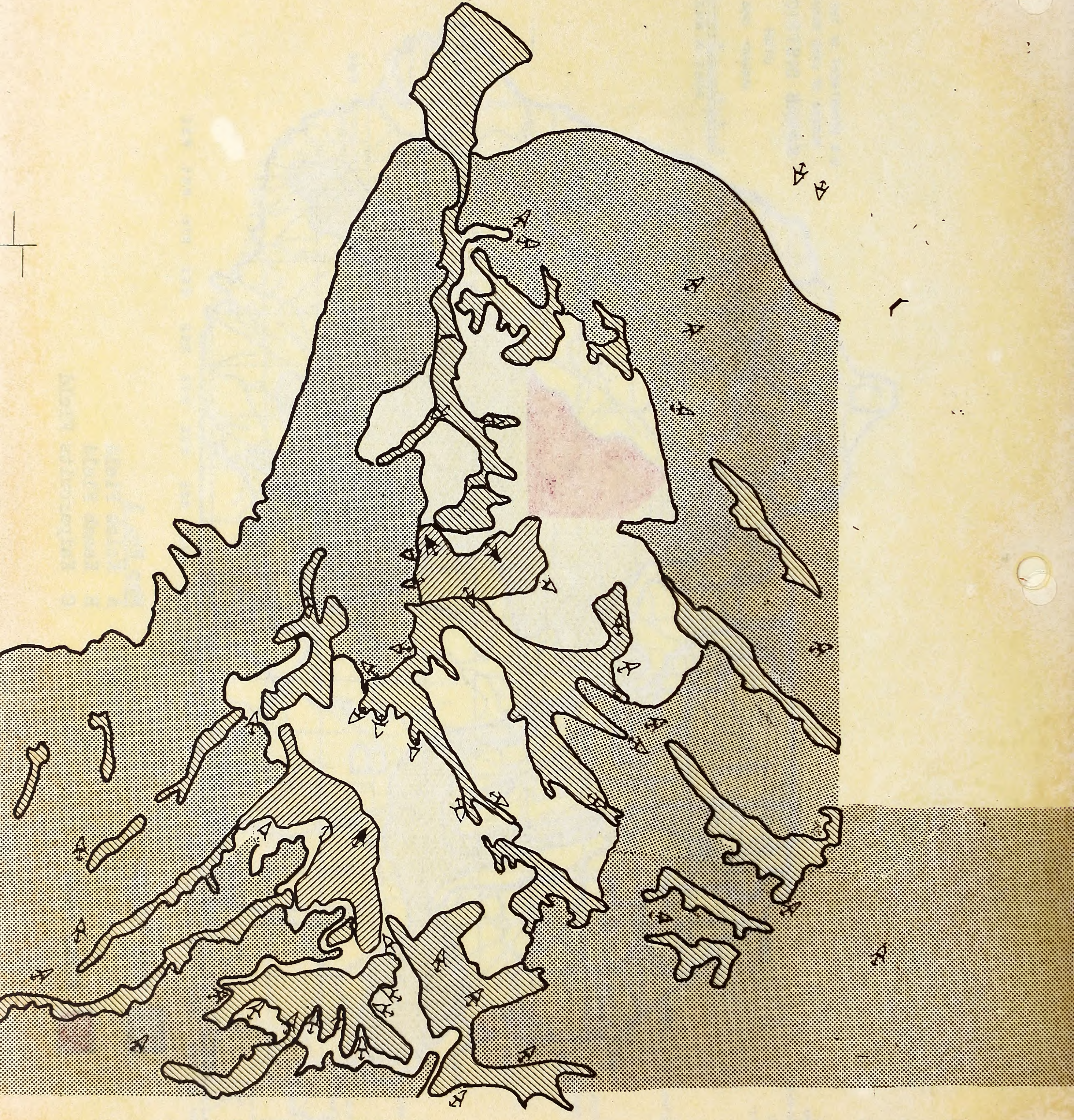
▨ POTENTIAL TREATMENT

▩ RESTRICTED USE

PROPOSED DAM

EXISTING DAM

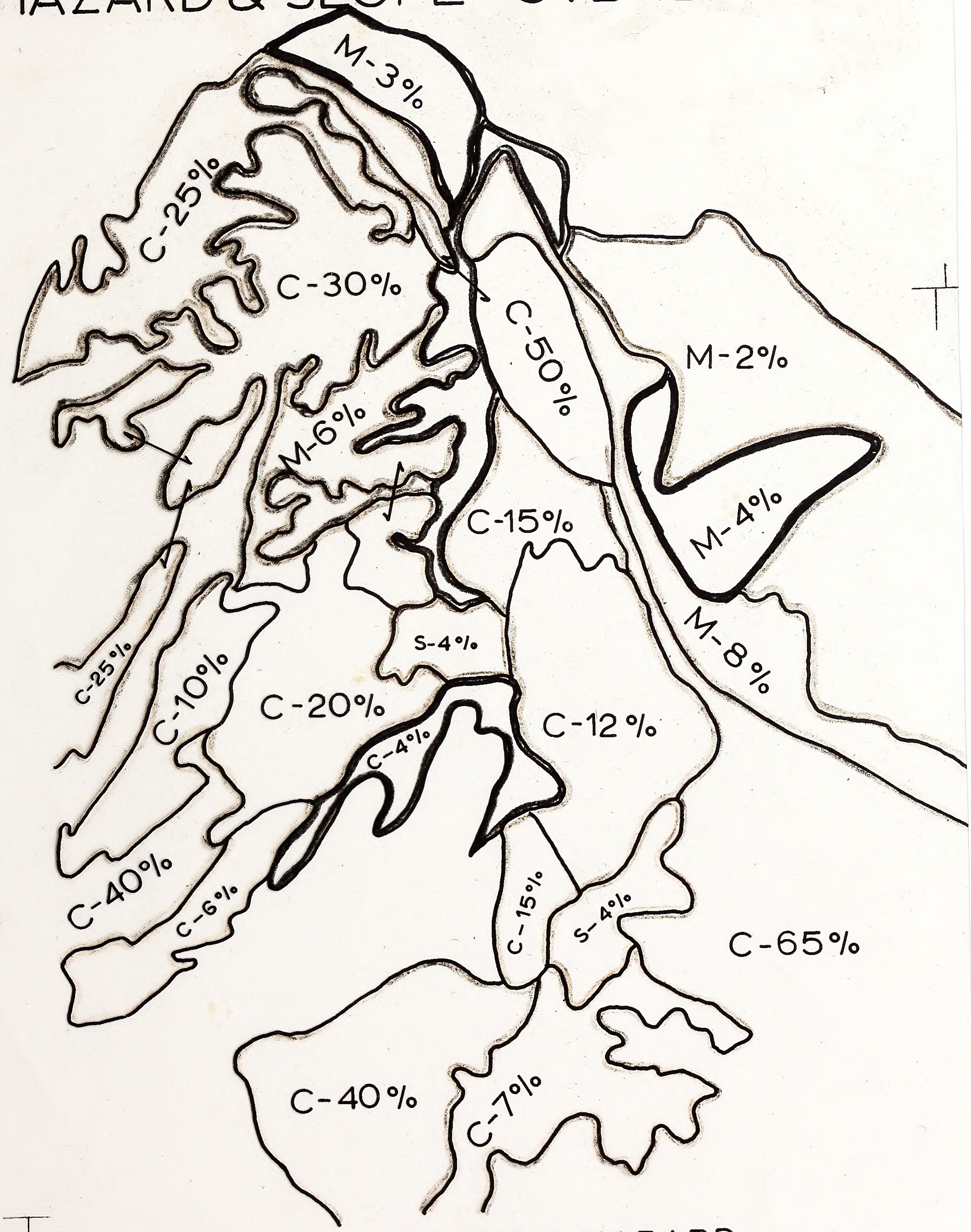
# WATERSHED M.F.P. OVERLAY



▨ TREATED AREA
▨ POTENTIAL TREATMENT
▨ RESTRICTED USE

PROPOSED DAM
EXISTING DAM

# VEGETATIVE TYPE - EROSION HAZARD & SLOPE OVERLAY

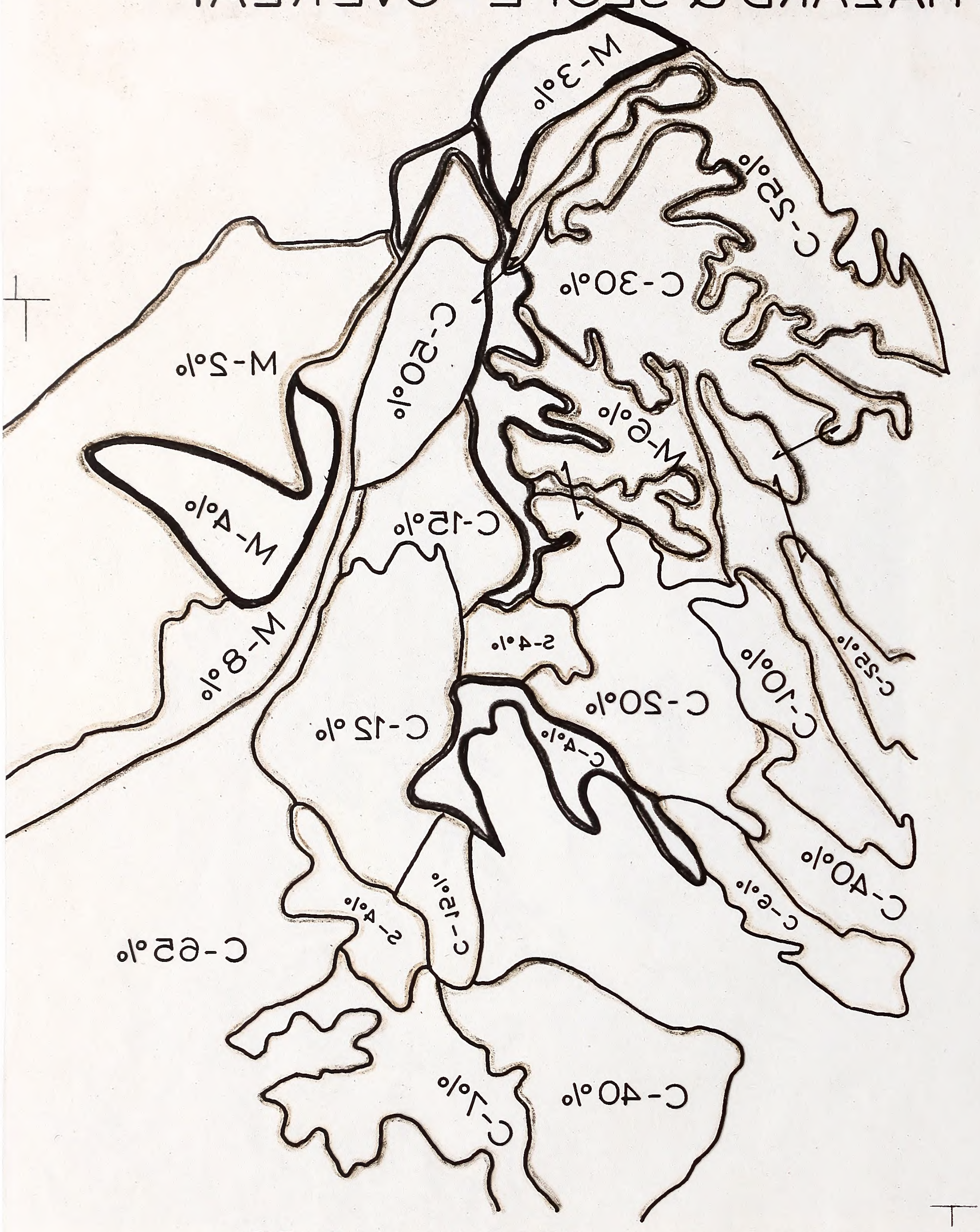


○ PINYON-JUNIPER
● SAGEBRUSH
○ GRASS
◎ WASTE

EROSION HAZARD
S= SLIGHT
M= MODERATE
C= CRITICAL

% = PERCENT SLOPE

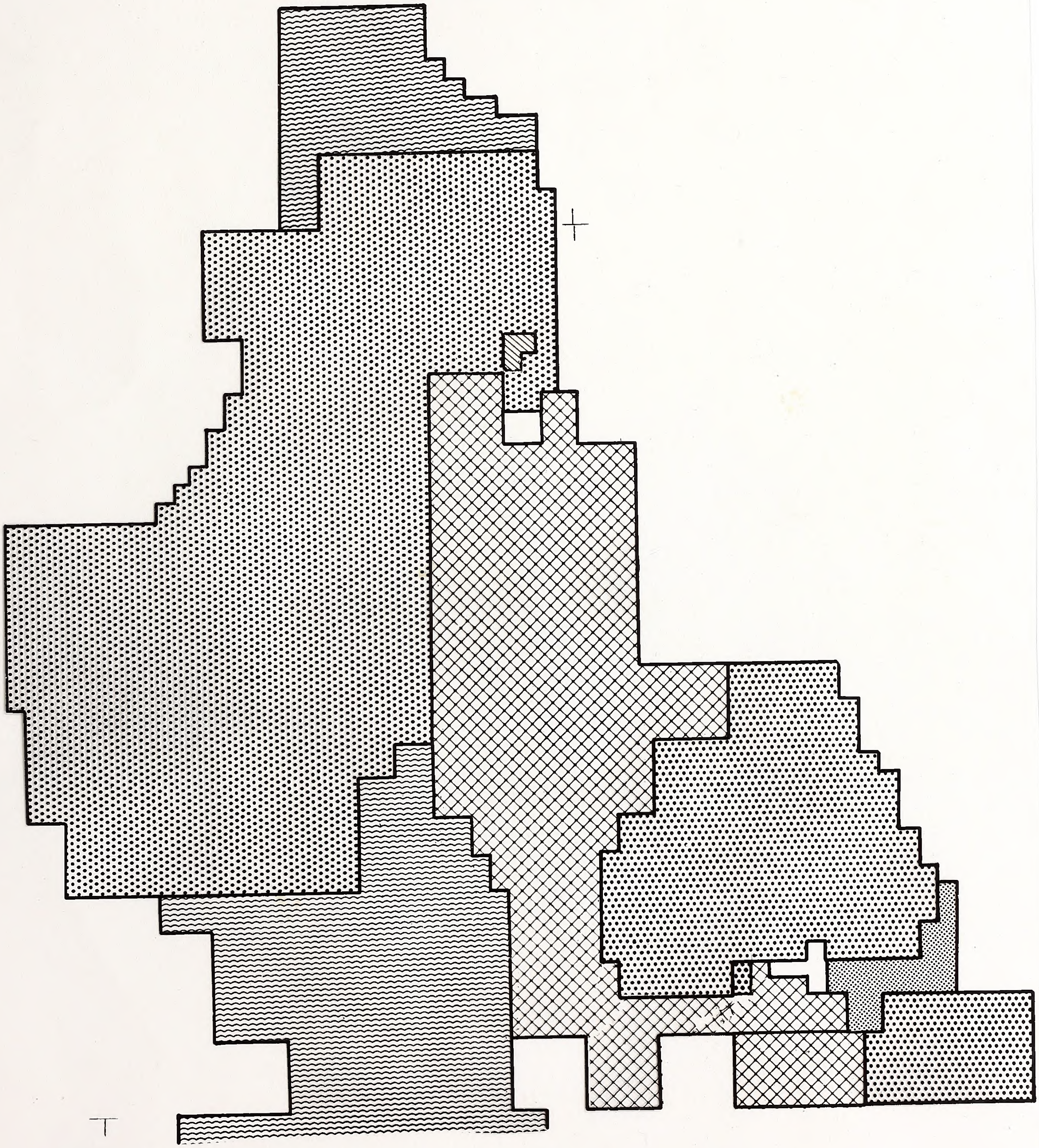
# VEGETATIVE TYPE - EROSION HAZARD & SLOPE OVERLAY



○ PINYON-JUNIPER
● SAGEBRUSH
○ GRASS
○ WASTE

EROSION HAZARD
S = SLIGHT
M= MODERATE
C= CRITICAL
% = PERCENT SLOPE

# COAL PERMIT & LEASE OVERLAY FOR MAP-2



☐ DELCOAL

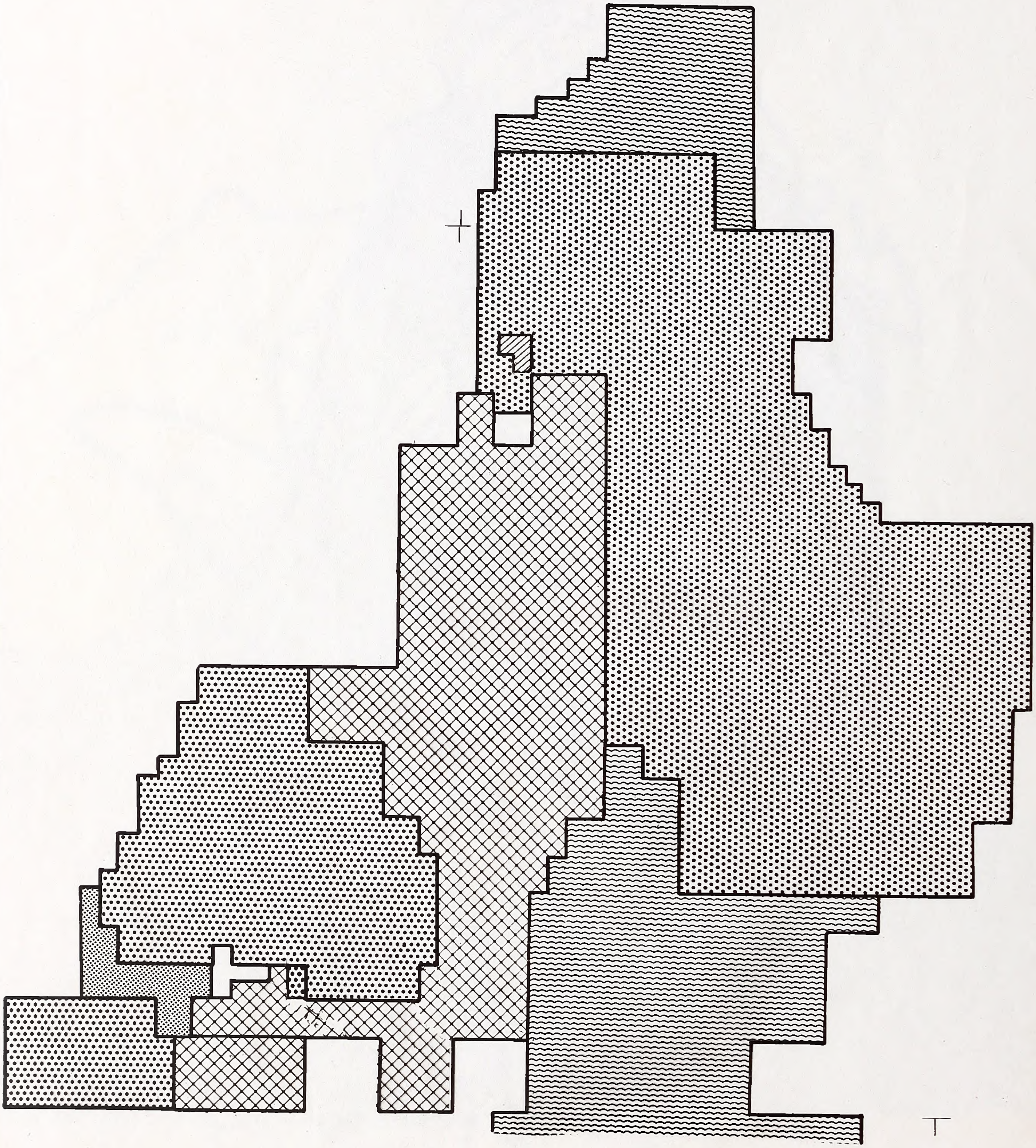
▤ SUN OIL

▦ WOODS PETROLEUM

▨ FRANDSEN

▩ COMP. LEASE

# COAL PERMIT & LEASE OVERLAY FOR MAP-2



☐ DELCOAL

▤ SUN OIL

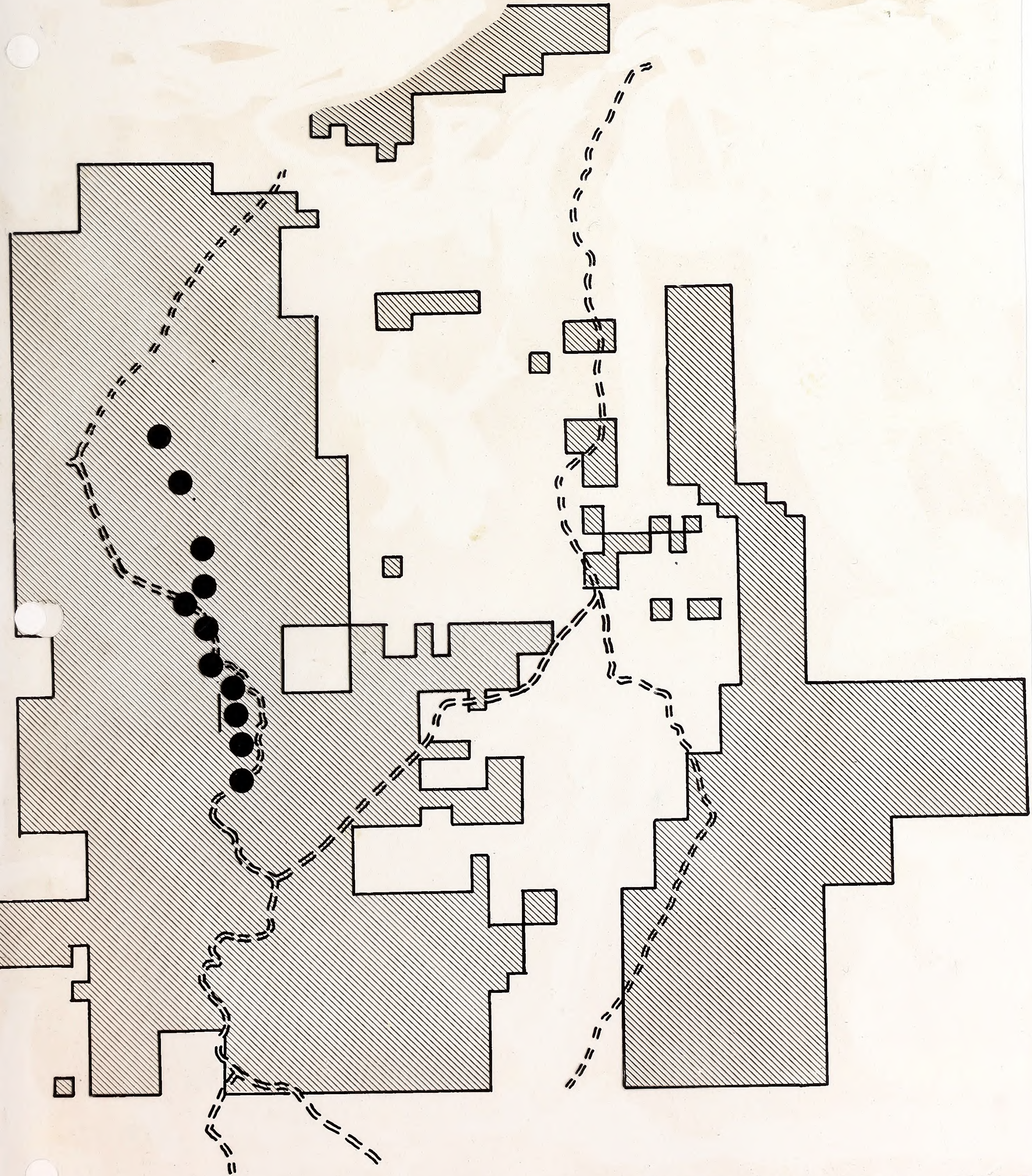
▩ WOODS PETROLEUM

▨ FRANDSEN

▦ COMP. LEASE

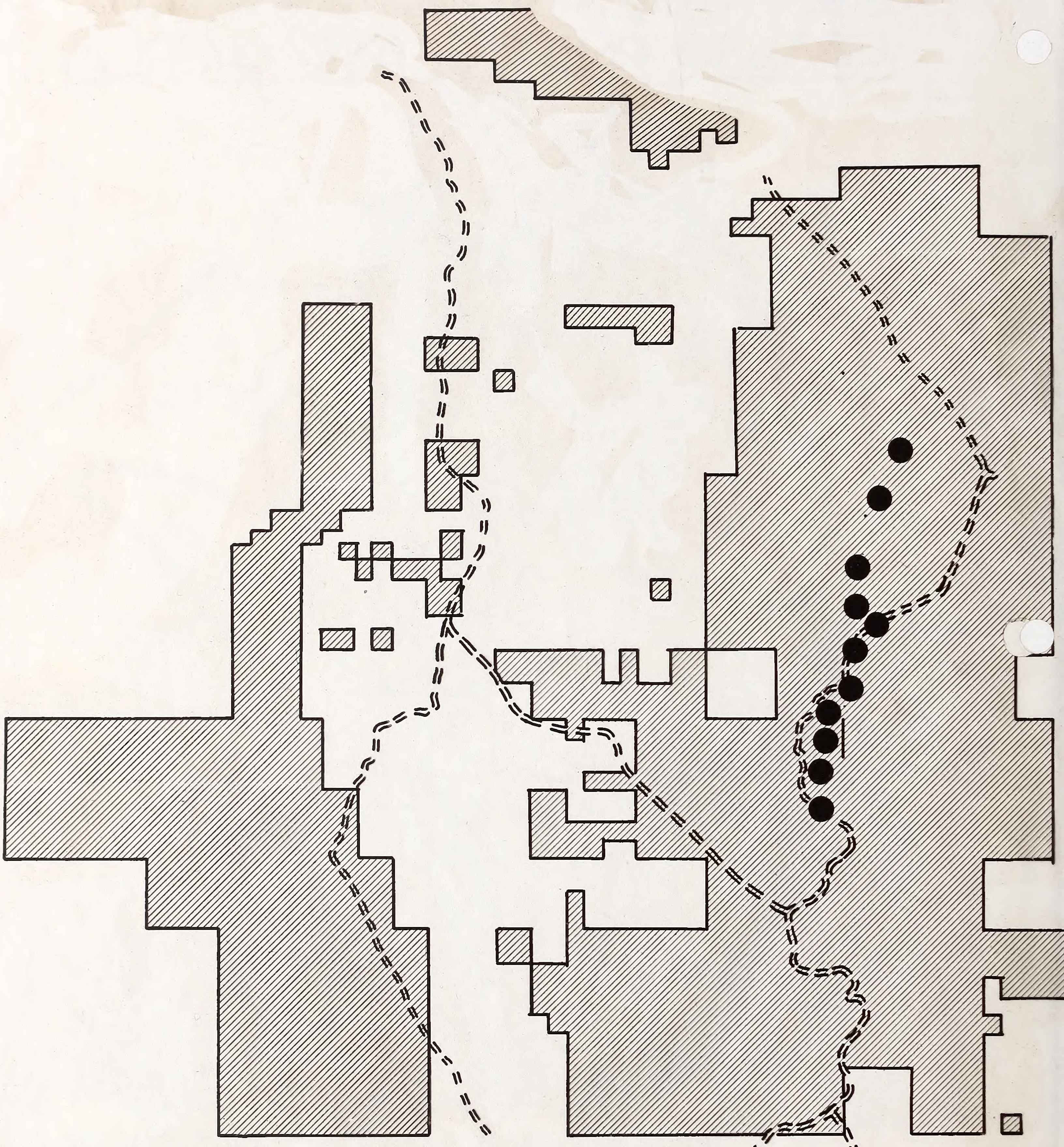
2

# ACCESS-OIL & GAS LEASE OVERLAY



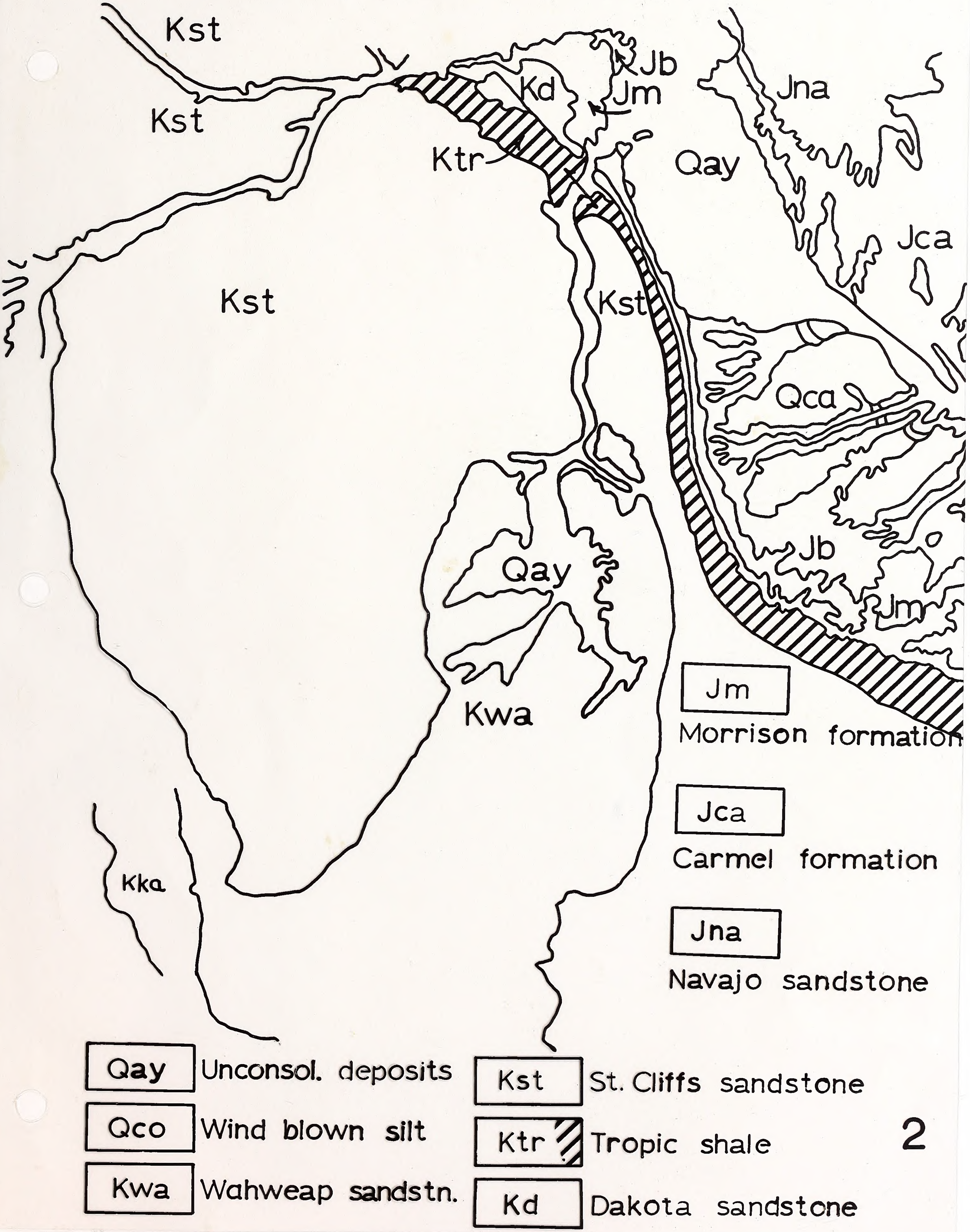
● PRODUCING TENNECO UPPER VALLEY WELLS

# ACCESS-OIL & GAS LEASE OVERLAY

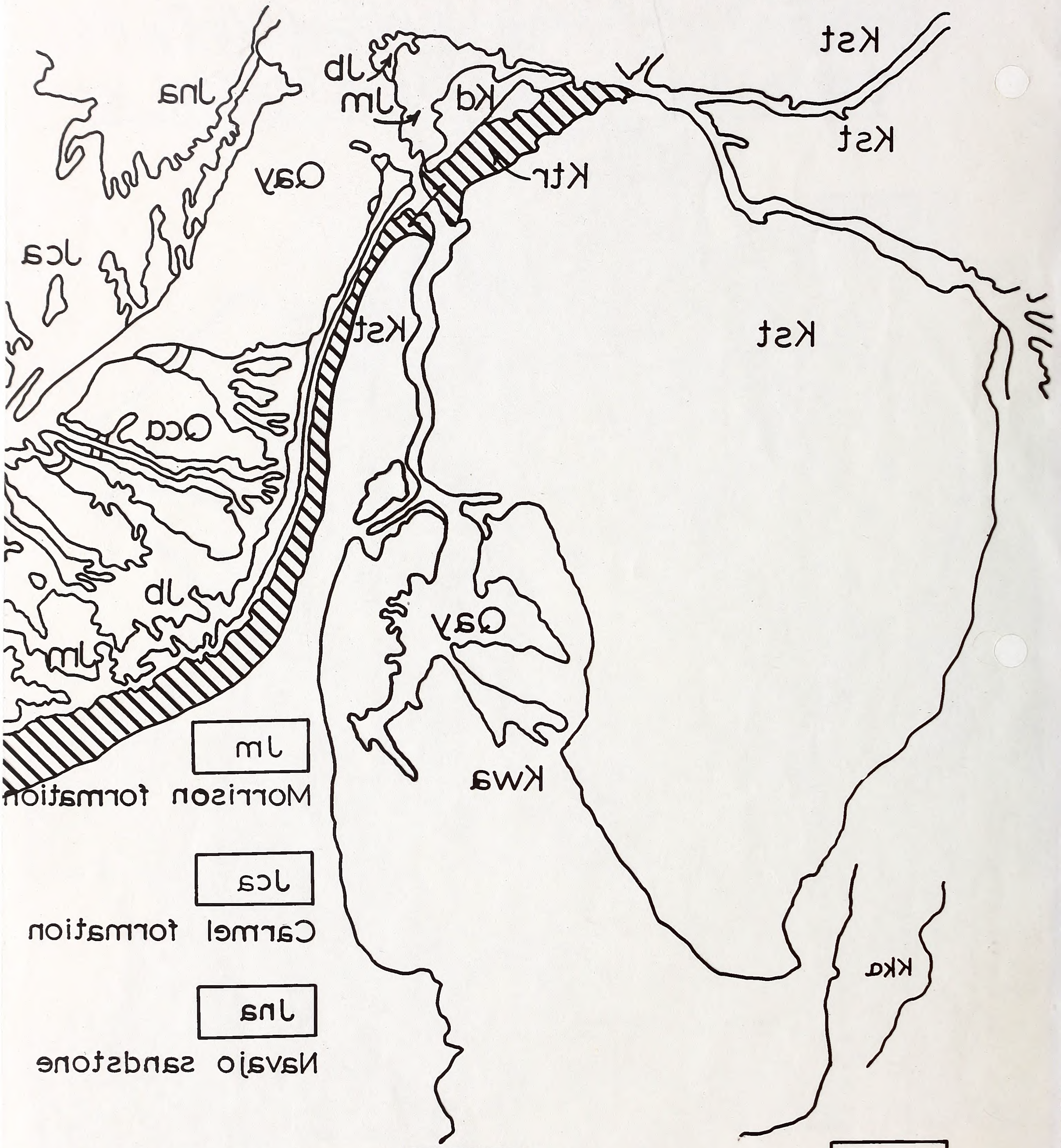


● PRODUCING TENNECO UPPER VALLEY WELLS

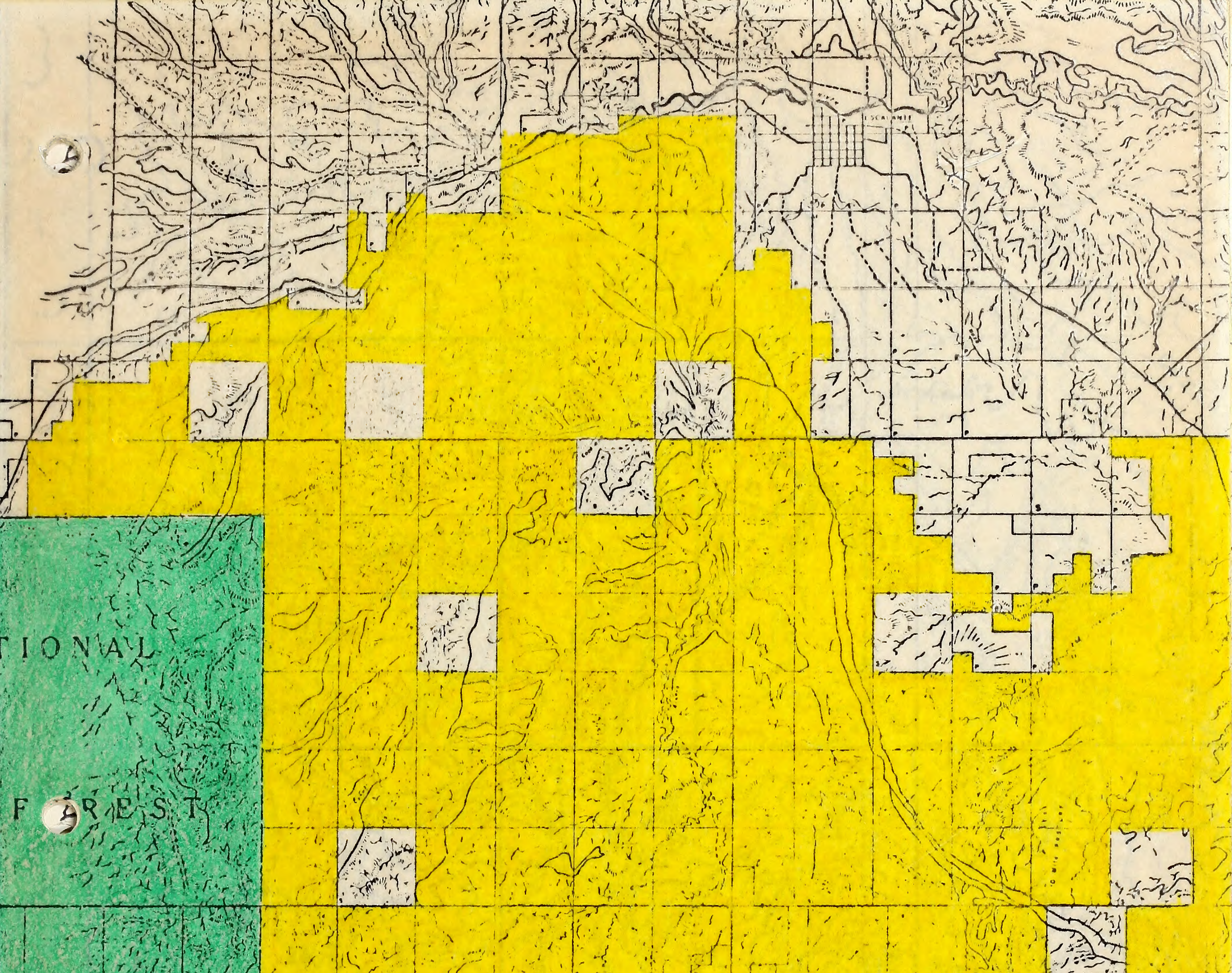
# GEOLOGIC OVERLAY



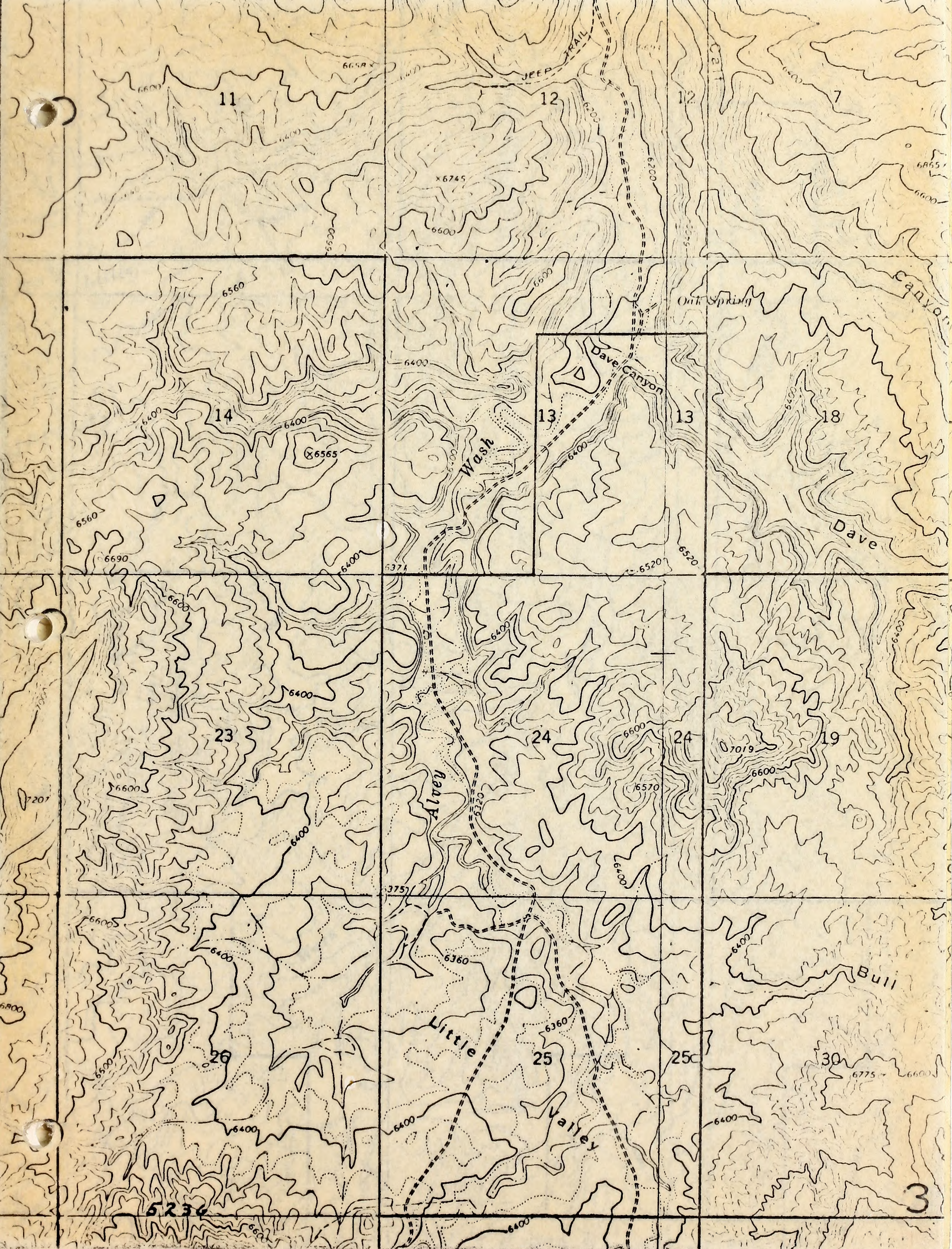
# GEOLOGIC OVERLAY

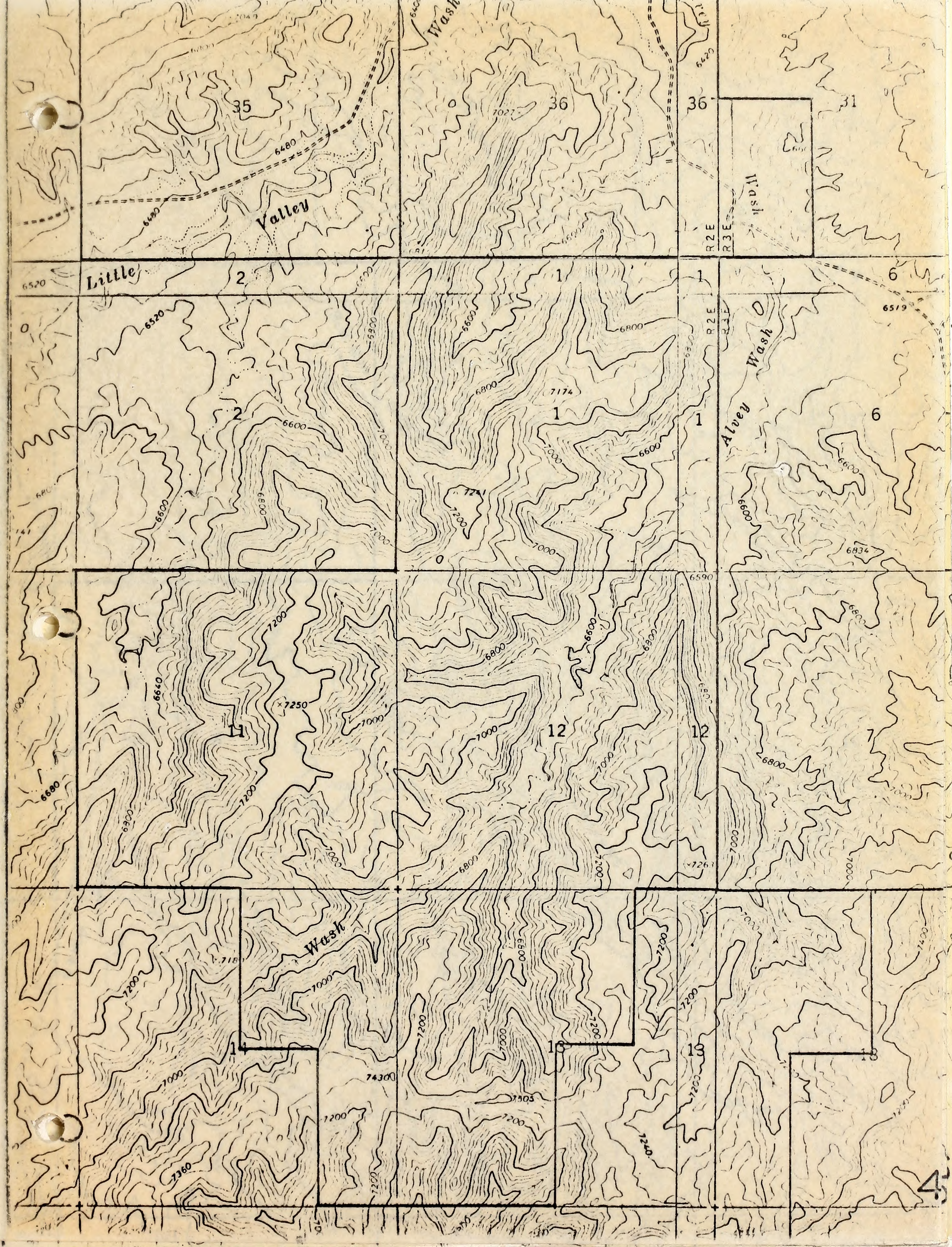


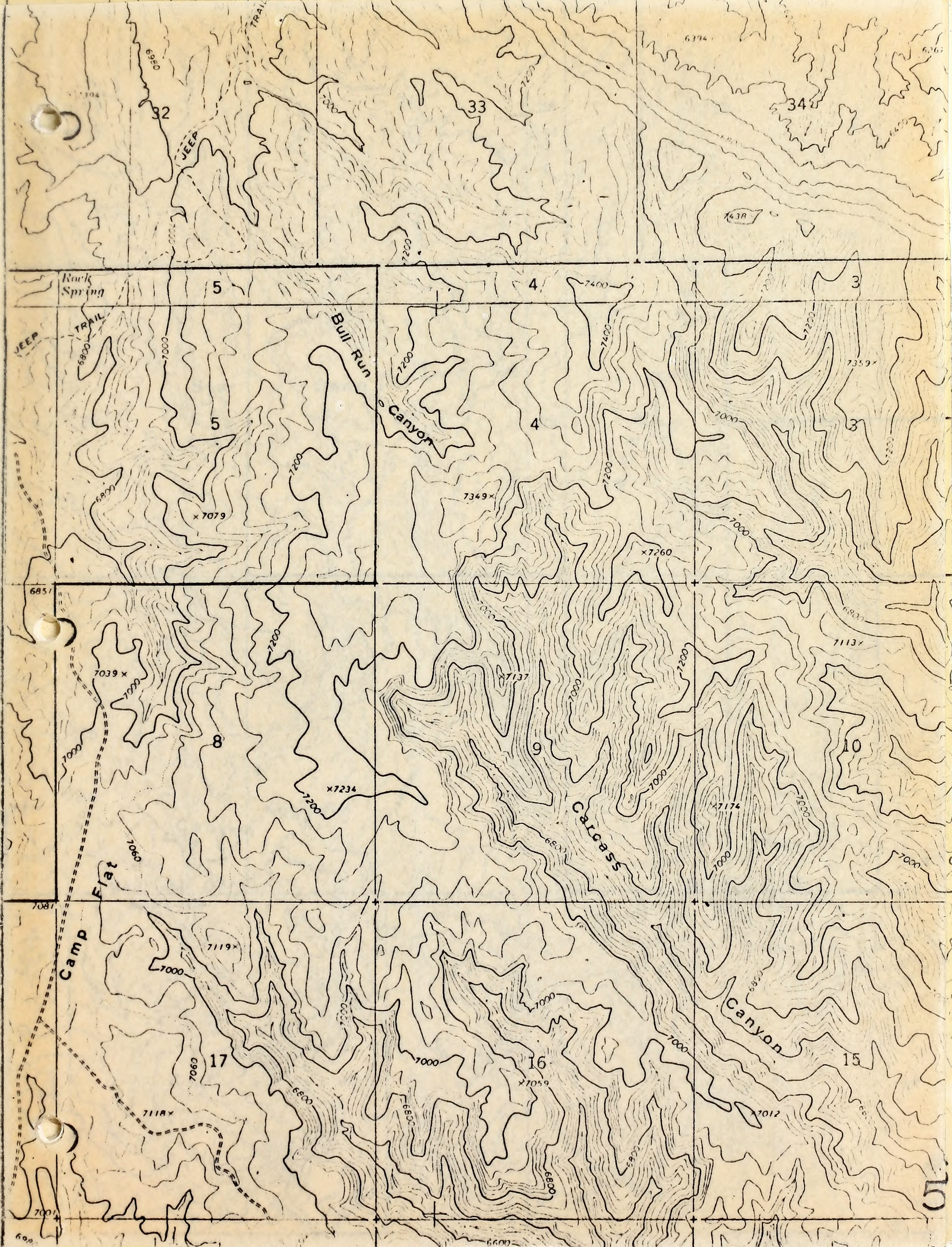
| | |
|---|---|
| Jm | Morrison formation |
| Jca | Carmel formation |
| Jna | Navajo sandstone |
| Kst | St. Cliffs sandstone |
| ▨ Ktr | Tropic shale |
| Kd | Dakota sandstone |
| Qay | Unconsol. deposits |
| Qco | Wind blown silt |
| Kwa | Wahweap sandstn. |

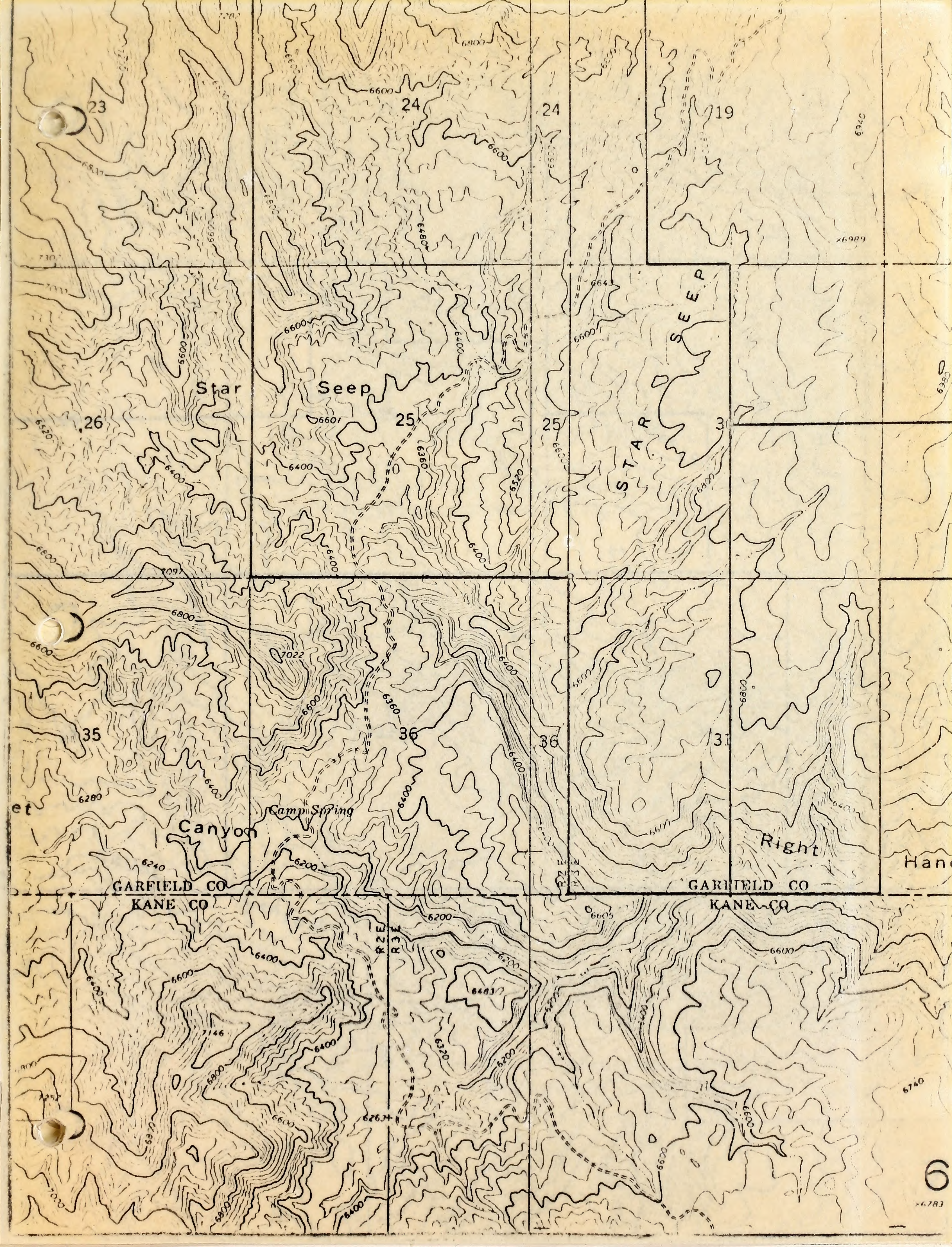


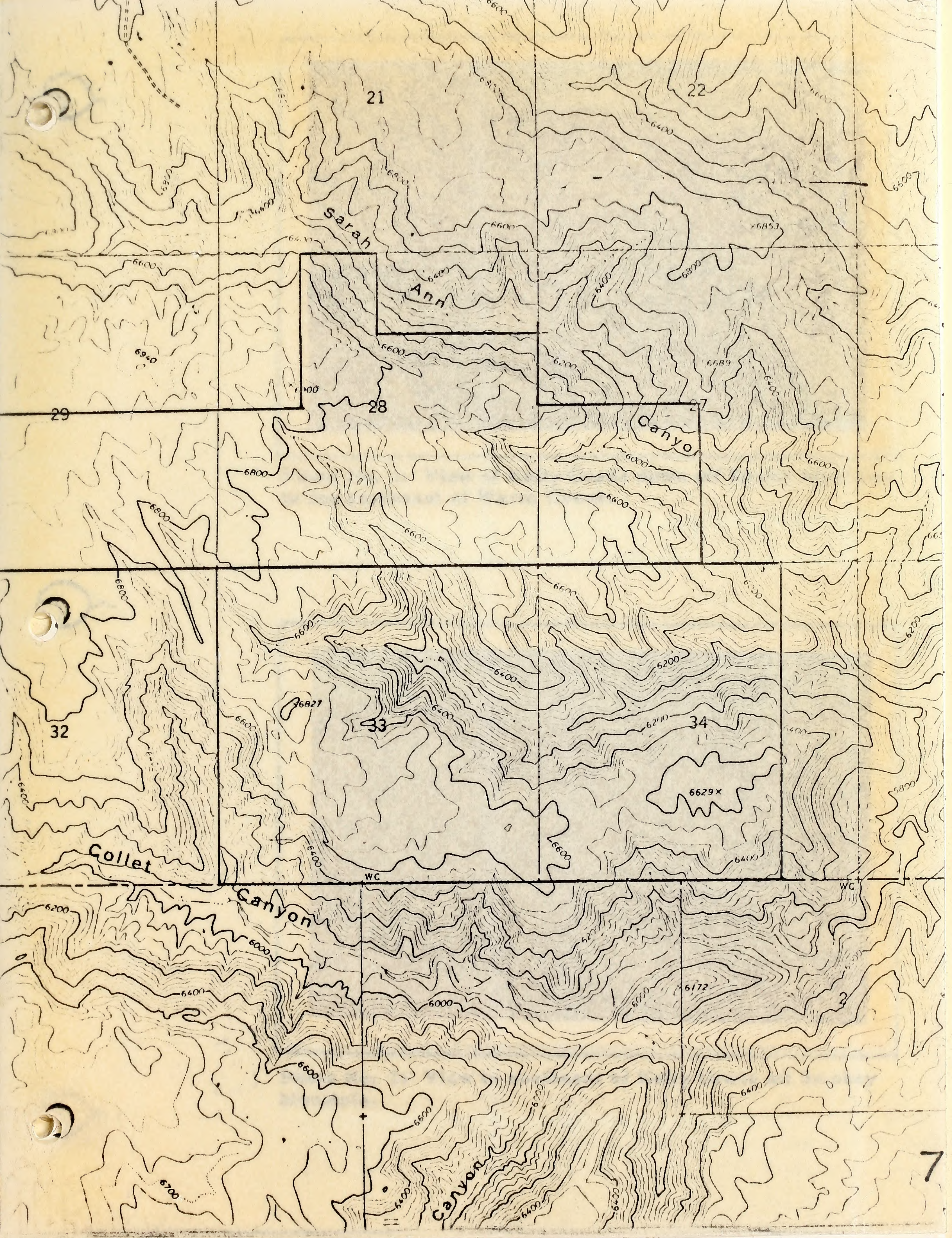
2 -


JEEP TRAIL
11
12
12
7
6658
6600
6745
6600
6865
Canyon
Oak Spring
Dave Canyon
6560
14
6400
6565
13
13
18
Wash
Dave
6560
6690
6371
6520
23
24
24
19
Alvey
6320
6600
7019
6570
7207
6400
6375
6360
6360
Bull
Little
25
25c
30
26
6775
6800
Valley
6400
5236


35
36
36
31
Wash
Valley
Little
Wash
R2E
R3E
R2E
R3E
1
1
2
6
2
1
1
6
Alvey Wash
11
12
12
7
Wash
14
13
13
18
6480
6520
6519
6600
6800
7000
7027
7174
7241
7200
6834
6590
6640
7250
6680
6300
7263
7180
7300
7303
7360
7240


32
33
34
JEEP
TRAIL
Rock Spring
5
4
3
JEEP TRAIL
Bull Run Canyon
7400
7200
7000
6800
7079
7349
7260
7359
8
9
10
7039
7137
7174
7113
7234
Carcass Canyon
Camp Flat
7060
7081
7119
17
16
15
7118
7059
7012
6851
6600
7001
6394
7438


23
24
24
19
Star
Seep
26
25
25
STAR SEEP
3
35
36
36
31
et
Canyon
Camp Spring
Right
Hand
GARFIELD CO
KANE CO
GARFIELD CO
KANE CO
R2E
R3E
6600
6800
6400
6200
6360
6520
6280
6240
6320
6601
6641
6605
6483
6263
7022
7146
6740
6989
6283
6


21
22
Sarah Ann Canyon
×6853
6940
6689
29
28
27
32
33
34
6827
6629×
Collet Canyon
WC
WC
6172
2
Canyon
6200
6400
6600
6800
6000
6700

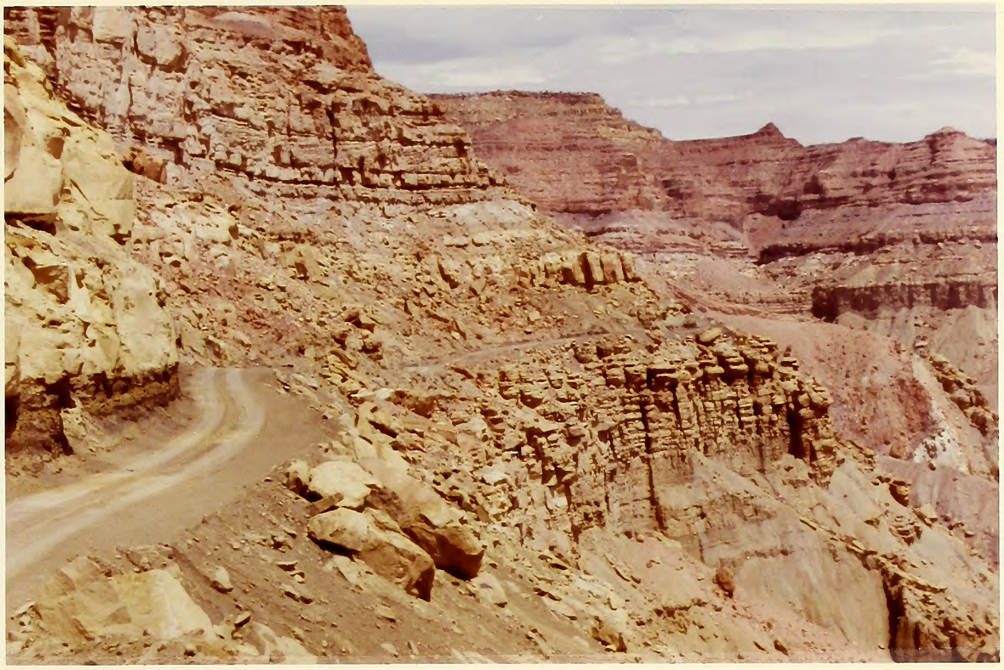


Photo No. 1: View of Kelly Grade down off Smoky Mountain to the northeast of Warm Creek.

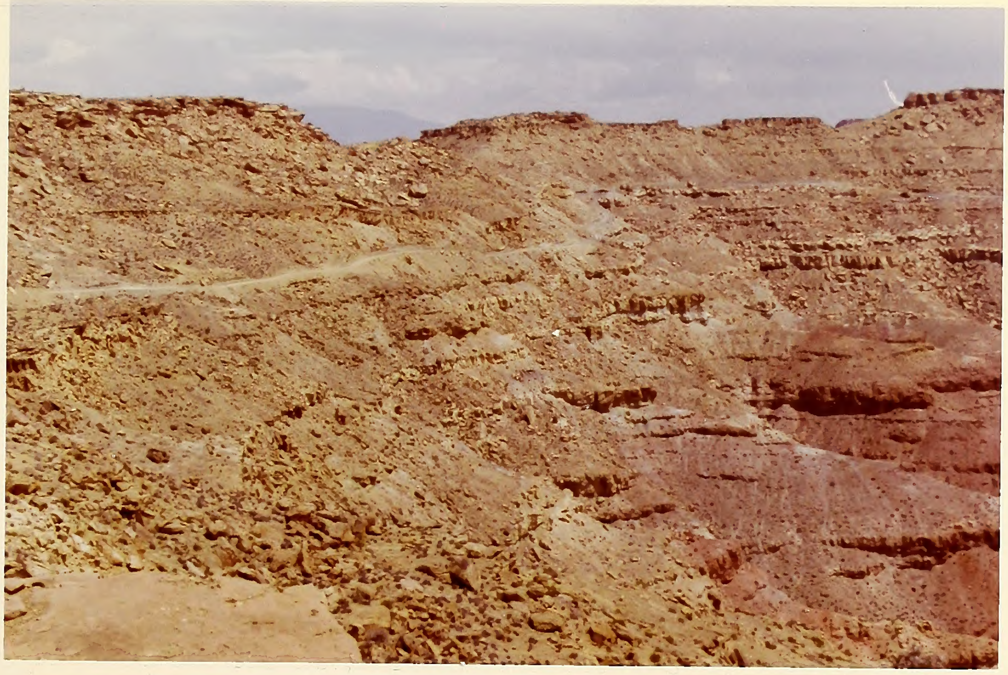


Photo No. 2: View to southeast of Kelly Grade off Smokey Mountain.

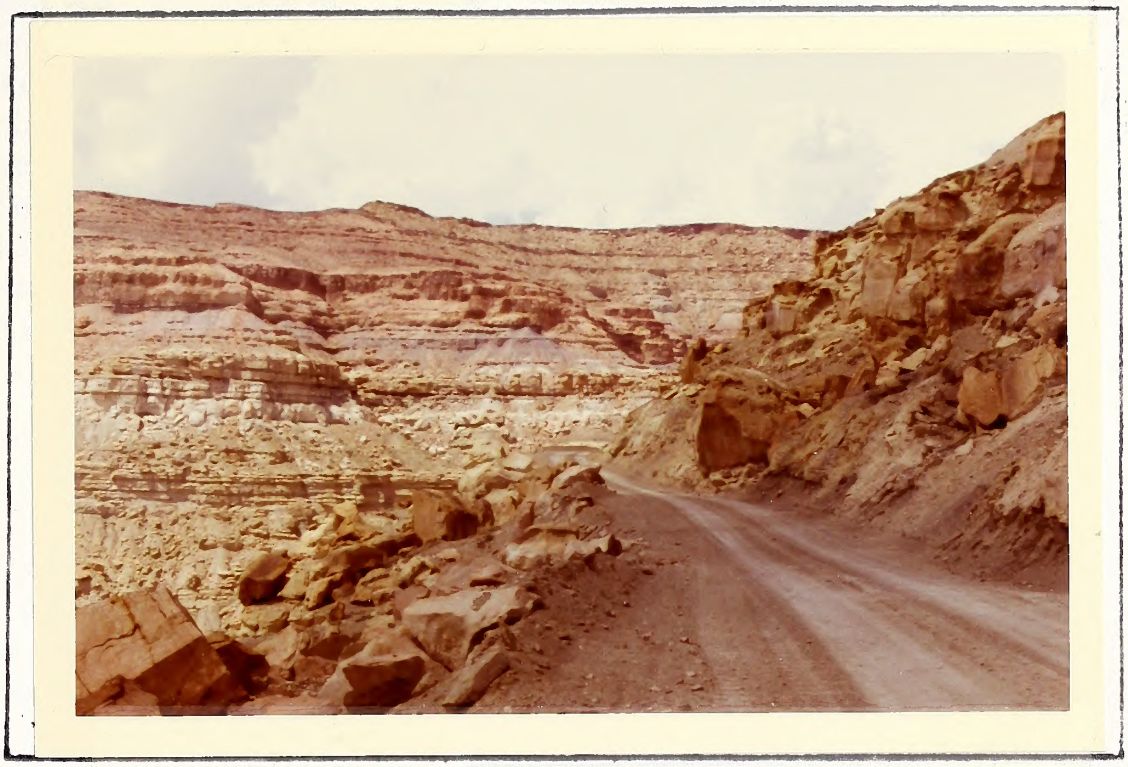


Photo No. 3: View to north of Kelly Grade.

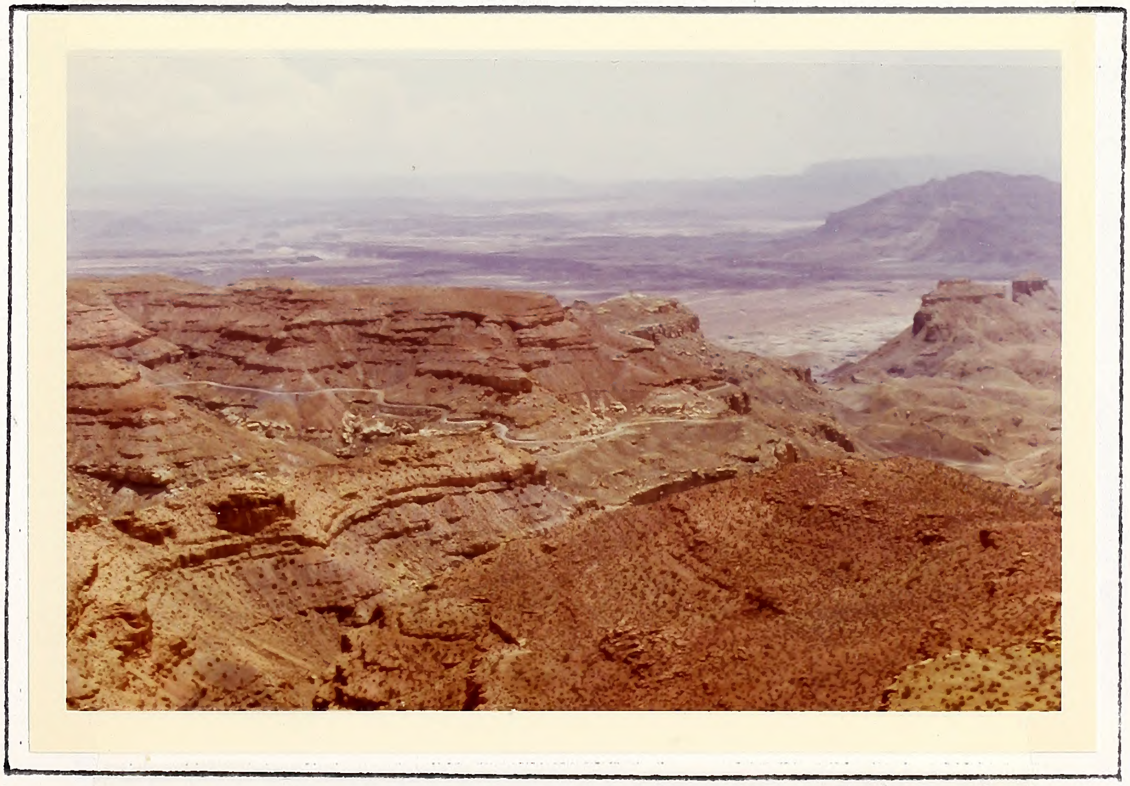


Photo No. 4: View to south with Lake Powell in background of Kelly Grade. Road was constructed by the late Don Kelly of Escalante in 1963. Construction time encompassed several months. Kelly initiated construction from the rim and worked down hill until tying in with the Warm Creek road.

Photo No. 5: View of Peabody Coal Company core sampling rig atop Smoky Mountain Peabody lease area. Photo was taken in July, 1970, at which time Peabody had completed some 60 sample drillings.

Photo No. 6: The view of completed Peabody test drilling on bench atop Smoky Mountain overlooking Last Chance drainage.

Photo No. 7: Closeup of Peabody drill rig with stem in place.

Photo No. 8: View of Fred P. Howard, Kanab District Manager, during July, 1970, field inspection of Peabody testing sites.

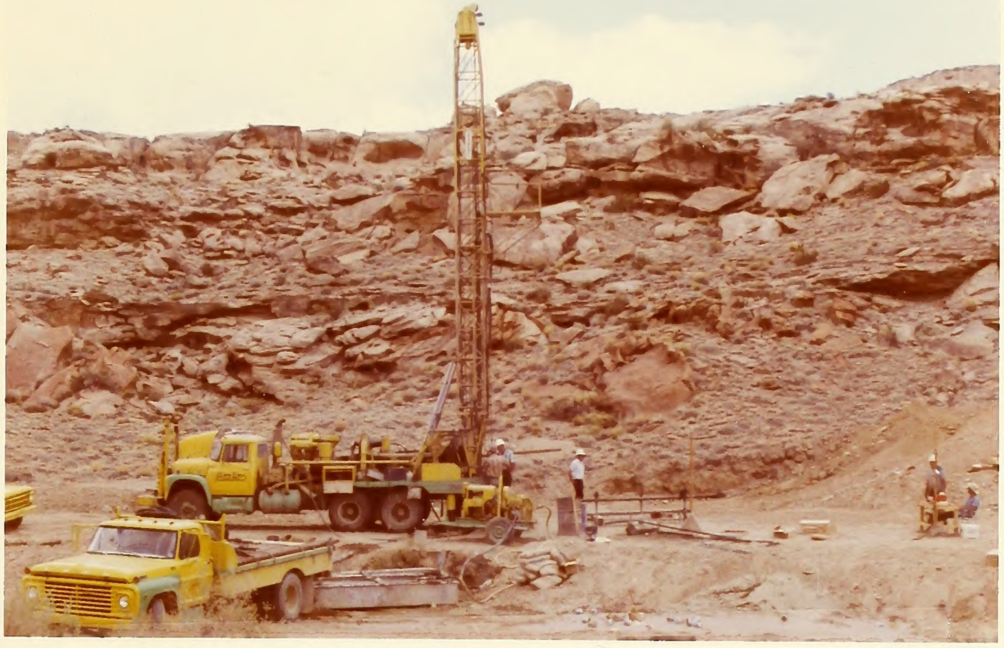


Photo No. 9: View of Boyles Brothers coal core sampling in Hidden Canyon atop Smoky Mountain area. Sampling work in this locale is under sub-contract from Bechtel Construction during the summer of 1970 as exploratory agents for Resources Company. Majority of public land on Warm Creek side of Smoky Mountain is under Resources Company coal lease.

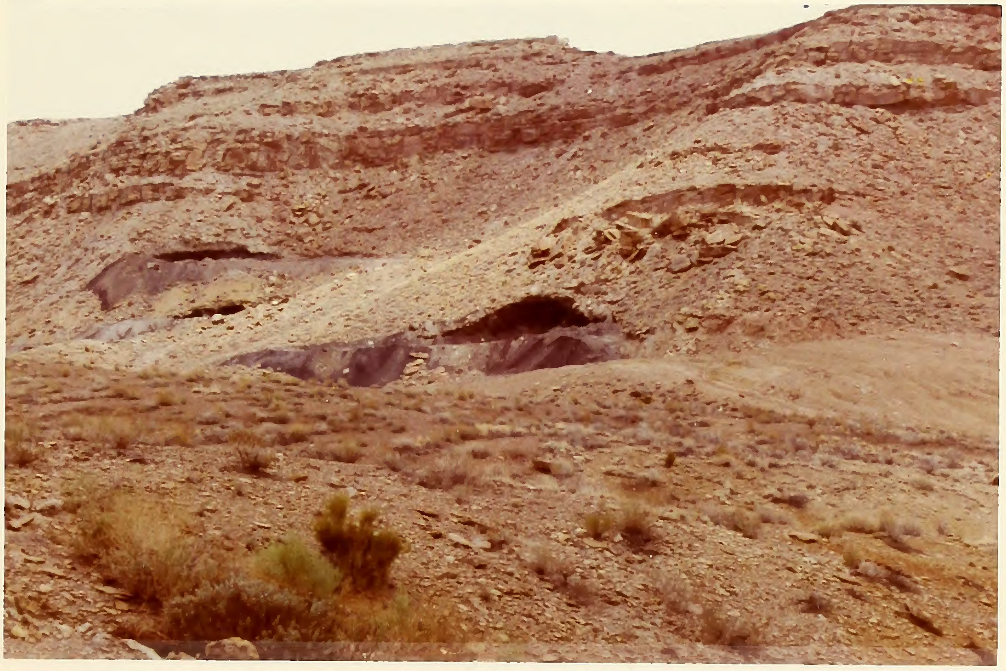
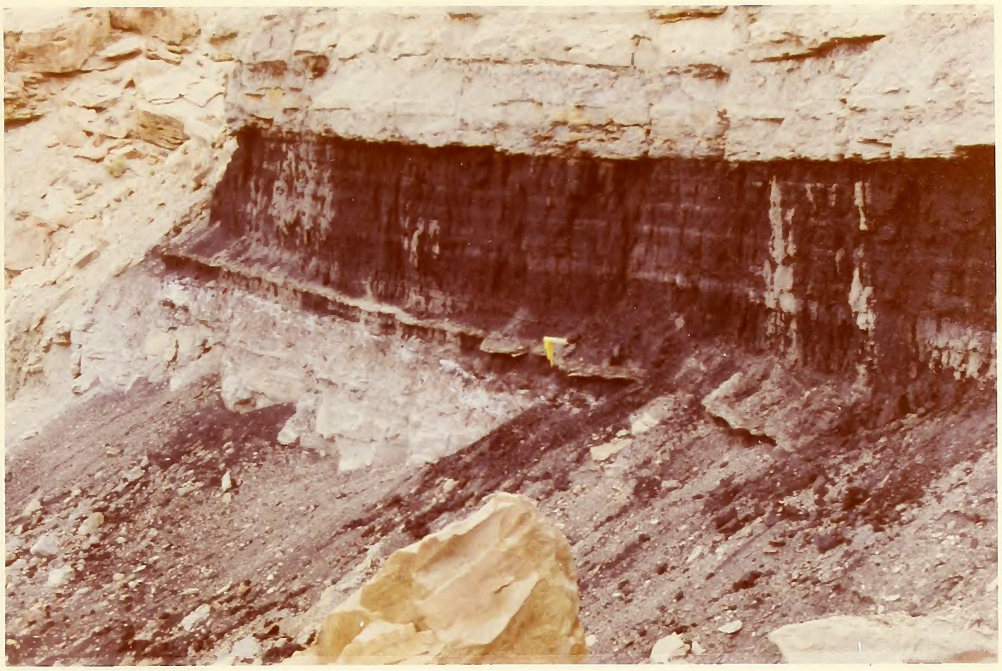


Photo No. 10: View to south of recent dugways exposing coal veins under tallus deposits in Hidden Canyon.

Photo No. 11: View of Boyles testing personnel at site in Hidden Canyon. Core sampling devise is seen in lower front of picture.

Photo No. 12: View of Boyles Brothers engineers with box samples of coal cores during July, 1970, testing.



View of recently exposed 8-foot coal seam located approximately 20 feet above larger coal seam pictured in Photo No. 14 below. These photos were similarly taken in Hidden Canyon.

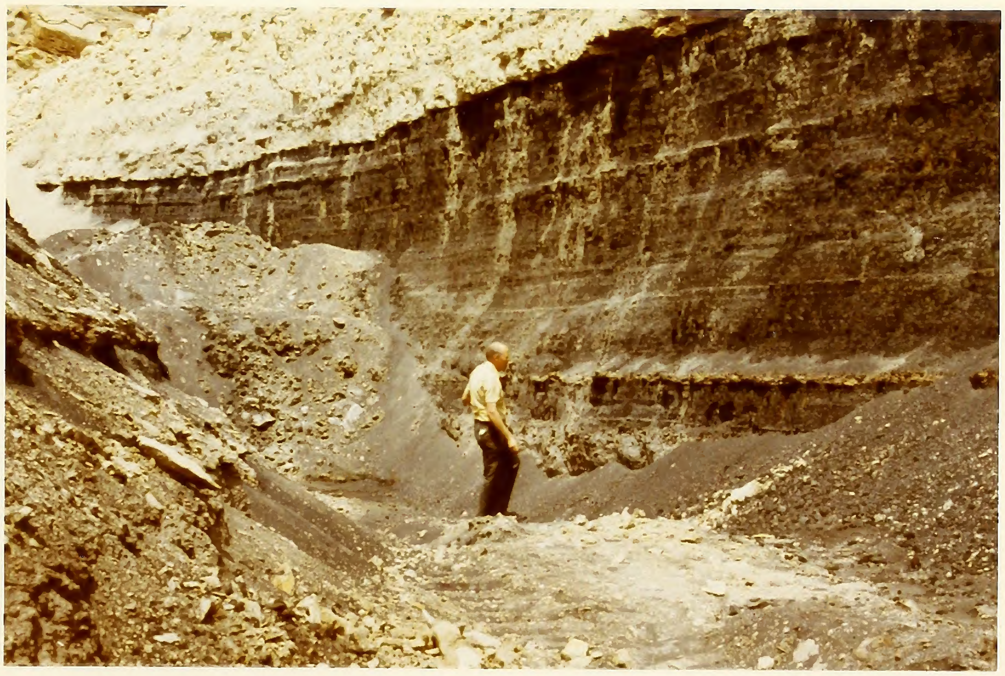


Photo No. 14: View of Fred P. Howard, Kanab District Manager, standing within recently excavated dugway. This seam of coal was the largest which was evident in the locale.

Photo 15, View of Alvey Wash in southeast corner of T. 36 S., R. 2 E. with BLM seedings in background to northwest.

Photo 16, View to north of BLM seeding along Alvey Wash road in northwest corner of T. 37 S., R. 3 E.

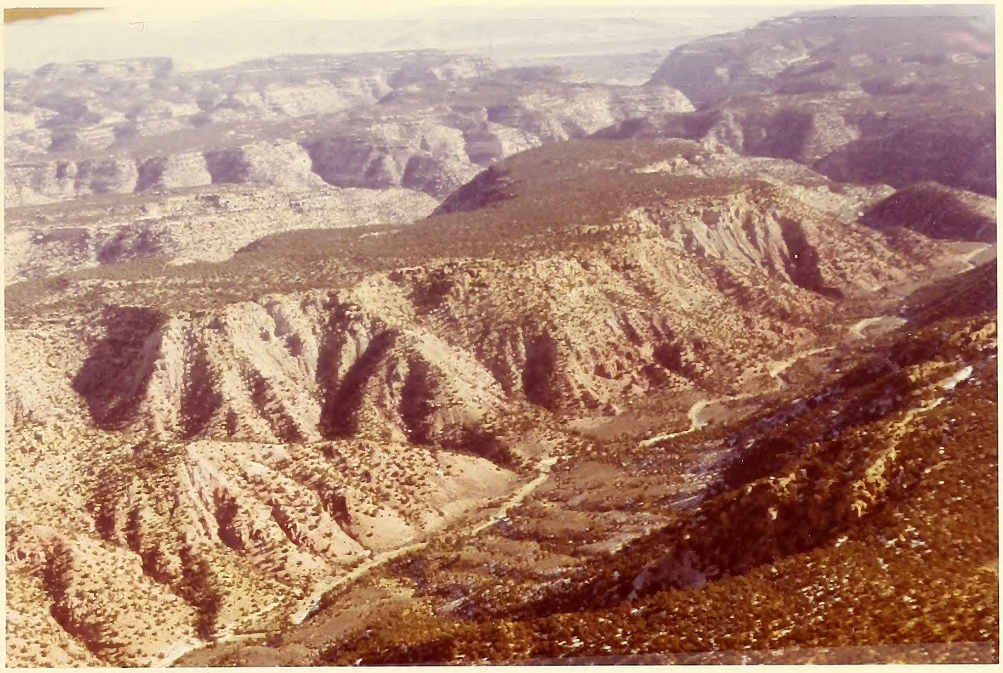


Photo 17, View of Colletts Canyon road with Delcoal preference lease and unassigned competitive lease lands to east in background. Photo taken from southern boundary of T. 37 S., R. 3 E.

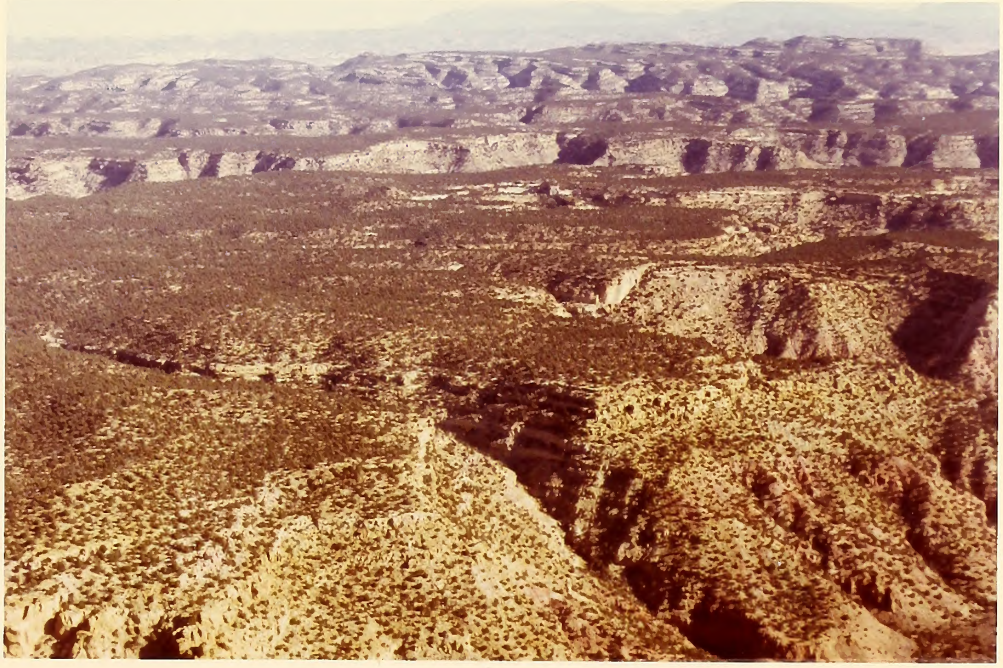


Photo 18, View to north of competitive lease lands in south west corner of T. 37 S., R. 3 E. depicting typical physiography of area.